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CLASSIFICATION OF SERAL COMMUNITIES FOR MAJOR FOREST HABITAT TYPES IN WESTERN MONTANA AND CENTRAL IDAHO

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SECOND ANNUAL PROGRESS REPORT, Study INT-1205-587

Classification of Seral Communities for Major Forest Habitat Types in Western Montana and Central Idaho

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June 1979

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Stephen F. Arno
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SECOND ANNUAL PROGRESS REPORT, Study INT-1205-587:

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PART A:

SUCCESSIONAL STAGES OF THE *PSEUDOTSUGA/VACCINIUM GLOBULARE* AND *ABIES LASIOCARPA/XEROPHYLLUM* HABITAT TYPES

Introduction and Field Sampling Procedures

The goal of this study is to develop classifications of common seral community types (based on key species and stand life-forms) for a few major habitat types and outline the successional sequences of community types on each habitat type. Classifications will ultimately be based upon extensive reconnaissance sampling (from our Research Work Unit's habitat type and successional studies) and results from the detailed annual sampling of forest succession on fixed plots being conducted by Peter Stickney and L. Jack Lyon (Lyon and Stickney 1976, Stickney 1979).

The first two years' limited efforts (totaling one scientist-man-year) have been directed toward accumulating and analysing a broad reconnaissance-plot data-base for three habitat types in west-central Montana. The first annual Progress Report (June 1978) presented a preliminary successional classification for the *Pseudotsuga/Physocarpus* (*PSME/PHMA*) habitat type in west-central Montana. During the second year, sampling and analysis was done on the *Pseudotsuga/Vaccinium*

globulare (*PSME/VAGL*) and *Abies lasiocarpa/Xerophyllum* (*ABLA/XETE*) h.t.s, which often occur immediately upslope from *PSME/PHMA* h.t.

Two to five stands (109 total were sampled on 38 different sites in the *PSME/VAGL* and *ABLA/XETE* habitat types (Pfister and others 1977) within about 50 miles of Missoula, Montana. Extensive field reconnaissance was made to locate sites having vegetational communities (stands) of different ages immediately adjacent to each other. Each of these paired stands on the same site had essentially the same elevation, aspect, slope steepness, and soil parent material. At each site there was a mature "untreated" stand ($\geq$ 120 years of age) which served as a sort of benchmark for comparison. Adjacent to the mature stand were one to four younger communities that had arisen after either wildfire (WF), or clearcut logging (CC). Clearcutting was followed either by no site preparation (CCNP) or by broadcast burning (CCBB) or mechanical scarification (CCMS). Clearcut stands where the slash was dozer-piled and burned are predominantly scarified and are considered part of the CCMS category. To avoid the additional complexity of dealing with short-lived early-seral dominant herbaceous plants, which have already been documented by Stickney (1979), we sampled only communities 5 years or older (since treatment).

A 375 m^2 circular plot was established in a representative portion of each stand on each site, and canopy coverage data for all herbaceous and woody plants including trees was recorded (Arno and Steele 1977). A tally was made of all trees by species and size class. Stand history was determined through analysis of increment cores taken near ground level, tree cross-sections including those from fire and logging scars

(Arno and Sneck 1977), and by consulting available land management records (e.g., at USDA Forest Service ranger stations).

The 38 sample sites represent the range of sites within *PSME/VAGL* and *ABLA/XETE* h.t.s (habitat types) in west-central Montana. The lower elevation sites (5,200 - 5,700 feet) lie near the *PSME/PHMA* h.t. (*Pseudotsuga/Physocarpus*), which was the subject of the previous season's successional classification efforts (1978 Progress Report). Higher elevation sample sites (6,500 - 7,000 feet) are bordered above by the *ABLA/LUHI* h.t. (*Abies lasiocarpa/Luzula hitchcockii*). The vast majority of sample sites occur on warm or intermediate exposures (aspects ranging from southeast to west), reflecting the relative dryness of these habitat types.

As an example of study sites, the greatest array of communities sampled on a single site occurs on a high south-facing slope west of Stevensville, Montana. Prior to 1910 the site was covered with mature *Pseudotsuga* forest, some of which remains (stand 10A--untreated). Part of this stand was killed by the 1910 wildfire and is now dense pole-sized *Pinus contorta* (10B--WF). Another part was clearcut, with the slash dozer-piled and burned in 1964 (10E--CCMS). Still another part was burned by an escaped fire at the same time (10C--WF). Both of these later two stands are naturally stocked with *Pinus contorta* saplings. And, finally, a wide strip cut at the same time was not treated afterwards (10D--CCNP). This strip has essentially lost *Vaccinium globulare* from the undergrowth and is without tree regeneration.

The array of sample stands in *PSME/VAGL* and *ABLA/XETE* h.t.s is shown by treatment type and age since treatment in Figure 1. Figure 2 shows the comparable data for *PSME/PHMA* h.t.

Analysis Procedures

Results of a preliminary analysis are being presented here to make them available for review and field testing during 1979.

Several index-of-similarity ordinations (Bary-Curtis as outlined in Pfister and Arno, 1979) were constructed based upon both the 38 untreated stands (≥ 120 year old stand on each site) and upon all 109 stands. These ordinations showed a strong gradient (X axis) evidently related to temperature among the 38 sites. The most consistent plant indicators of this gradient were *Pseudotsuga* (being a major component of mature stands on the warmer 2/3 of the sites), and *Vaccinium scoparium* (being well represented on the colder 1/3 of the sites). *Larix occidentalis* and *Calamagrostis rubescens* were strongly associated with these "warmer" 2/3 of the mature stands, henceforth called the "warm phase" of *ABLA/XETE* h.t. Most other "montane" forest species (e.g., *Pinus ponderosa*, *Amelanchier alnifolia*, *Ceanothus velutinus*, *Rosa gymnocarpa*, *Berberis repens*, *Arctostaphylos uva-ursi*, *Spiraea betulifolia*) were rather common on these warm phase sites (defined by *Pseudotsuga* being a major component of mature stands and *Vaccinium scoparium* being poorly represented). In contrast, the montane species are essentially absent from the "cold phase" sites, which have a less-diverse flora made up of the plants that can tolerate subalpine conditions.

Synthesis or stand tables (Mueller-Dombois and Ellenberg 1974) were constructed listing coverage values for each plant species in each stand within the "warm" and "cold" phases. Stands were grouped by structural characteristics and dominant species composition in the synthesis tables. Age since treatment and type of treatment were then related to the groups that had emerged. Species composition of treated stands was evaluated independently and in relation to the untreated stand on the same site.

A bivariate correlation analysis is currently being made to determine which of 48 site and vegetation variables are related to each other. Further data collection, input from local foresters, field testing, and continuing analysis will allow refinement of the emerging successional classification presented here.

Results and Discussion

SUCCESSIONAL STAGES AND COMMUNITIES IN *PSME/VAGL* and *ABLA/XETE* h.t., WARM PHASE

Figure 3 shows the successional stages (structural stages across top of figure) for the *PSME/VAGL* h.t. and *ABLA/XETE* h.t., warm phase sites. The range of tree canopy coverages, basal areas, dominant tree diameters, and ages since treatment are shown for each stage. Community types named for the dominant species in both the tree layer and undergrowth are then shown within each stage.

Table 1 is an abbreviated synthesis table showing structural and compositional characteristics of each stand in each community type. It also shows the composition of the untreated stand paired with each treated stand. The reader can gain an understanding of the range of variation found within each community type by inspecting Table 1.

Appendix C is a simple key for identifying successional stages and undergrowth community types in the *PSME/VAGL* and *ABLA/XETE* h.t.s. (A comparable key for the *PSME/PHMA* h.t. appeared in the 1978 Progress Report.)

Undergrowth Response to Treatment

VAGL-XETE (Figure 3) is the self-perpetuating undergrowth in all untreated ("mature seral forest" and "old growth") stands. This *VAGL-XETE* layer can be regarded as the end point of undergrowth succession for nearly all treatments on nearly all sites.

On the warmest sites (lowest elevations, often having some *Pinus ponderosa* in natural stands) *Amelanchier*, fire-dependent, *Ceanothus*, *Lonicera*, and other medium and tall shrubs usually form the dominant seral undergrowth regardless of treatment type. This taller shrub layer gradually gives way to *VAGL-XETE* as a dense conifer stand develops overhead. This situation as well as the next one are diagrammed as successional pathway "A" in Figure 3.

On wet sites (where *Larix occidentalis* is a dominant in natural stands) bordering the *Abies lasiocarpa/Menziesia* or *Abies/Linnaea* h.t.s (Pfister and others 1977) *Ribes*, *Salix*, and other medium and tall shrubs form the dominant seral undergrowth (often superimposed on a *VAGL-XETE* layer) after a burn or scarification treatment. This also gives way to *VAGL-XETE* as the conifer canopy closes overhead.

The following successional sequence (pathway "B" in Figure 3) applies to all but the warmest and wettest sites just mentioned. *VAGL-XETE* forms the early ($\geq$ 5 years after treatment) community type on "moderate" sites (i.e., those not on steep south or west exposures or

having especially droughty soils) following "moderate" treatments (e.g., a cool broadcast burn, light scarification, or CCNP).

If the site is on a steep south or west exposure or is subject to a hot wildfire or broadcast burn *VAGL* usually dies back leaving *XETE* and *CARU* as the undergrowth dominants (pathway "C"). The remaining *VAGL* is stunted and confined to shady-moist-protected microsites next to large rocks and logs, and beneath the canopy of saplings. As the sapling coverage increases so does coverage of *VAGL*, leading again to a *VAGL-XETE* undergrowth.

If a site is scarified, or if it occurs on a steep south exposure or windy ridgecrest and receives a hot burn, both *VAGL* and *XETE* usually die back and the early ($\geq$ 5 years) successional community is dominated by *CARU* and *CAGE* (depicted in pathway "D"). An apparent variation on this theme has occurred on much of the Sleeping Child Burn, a hot 1961 wildfire on a site having droughty surface soils. In this case (pathway "E") potential dominance by *CARU* and *CAGE* was pre-empted by an extremely dense layer of *Pinus contorta* regeneration. (The pre-burn stand was dominated by *Pinus contorta*.)

Where the treatment is very severe (e.g., deep scarification or a hot burn on an exposed site coupled with heavy grazing use), *Carex rossii*, *Achillea millefolium*, *Anaphalis margaritaceae*, and *Epilobium angustifolium* become dominant in early seral conditions. Introduced species such as *Cirsium* and *Trifolium* spp. may also become prominent. In some cases the undergrowth may not regain a natural *VAGL-XETE* composition even when a pole stage develops (pathway "F").

Tree Regeneration

Amount of time required to obtain adequate tree regeneration (300 one-foot-tall seedlings per acre) varied by treatment type (Table 2). CCNP stands were slowest to regenerate (averaging more than 23 years) and generally came back to more shade-tolerant *Pseudotsuga* and *Abies lasiocarpa*. CCBB stands averaged more than 15 years to regenerate and had numerous planting failures (Table 3). CCMS and WF stands regenerated sooner, primarily with *Pinus contorta* and secondarily with *Pseudotsuga*. CCMS regeneration was quite prompt in the cold phase of *ABLA/XETE* h.t. probably because of the predominance of *Pinus contorta* seed source and less competition from ground cover (*CARU* and *CAGE*) after treatment. WF stands probably regenerated faster than those in CCBB because of more complete litter-layer removal and residual seed source in the canopies of large burned trees.

The meager data estimating planting success in Table 3 suggest that planting has generally been either unnecessary or unsuccessful on these habitat types.

Tree Succession

Tree succession has followed a predictable trend related to tolerance. In the *ABLA/XETE* h.t. warm phase, most sapling and dense pole stage communities (arising after WF and presumably those that will develop after CCBB and CCMS) are dominated by *Pinus contorta* with a lesser amount of *Pseudotsuga*. *Pseudotsuga* is able to assume dominance in most > 100-year-old stands (mature seral forest) because of its greater shade tolerance, longevity, and often greater maximum height. *Abies lasiocarpa* is generally not very vigorous because of marginally

dry conditions and aggressive competition from the semi-shade-tolerant and drought-resistant *Pseudotsuga*. Thus *Abies lasiocarpa* usually requires 200 years after wildfire to become a major stand component. Moreover, *Abies lasiocarpa* is generally killed even by a relatively light ground fire, while *Pseudotsuga*, *Larix* (often a minor stand component), and occasionally *Pinus contorta* survive underburning.

Further discussion of overstory succession and its implications for management is presented in Part B of this report.

SUCCESSIONAL STAGES AND COMMUNITIES IN *ABLA/XETE* H.T., COLD PHASE

The cold phase of *ABLA/XETE* h.t. differs from the warm phase and from *PSME/VAGL* h.t. in having only minor amounts *Pseudotsuga* and in having *Vaccinium scoparium* (*VASC*) as a major component of forest under-undergrowth. Succession here (Figure 4) parallels that found in the warmer sites (Figure 3) with some interesting differences. Tree regeneration is attained about as rapidly as in the warmer sites, and perhaps more-rapidly (than on the warmer sites) after CCMS because of less herbaceous competition. However, development of the forest layer proceeds more slowly and the trees are smaller than on the warmer sites, where *Pseudotsuga* and *Larix* occur.

VASC is added to the *VAGL-XETE* undergrowth and it responds to treatment very much like *VAGL* (Figures 4 and 3). Medium and tall seral shrubs (*Amelanchier*, *Ceanothus*, *Ribes viscosissimum*, and *Salix scouleriana*) from the lower forest zones do not have the potential to form a significant component of seral stands. However, in other respects the undergrowth succession is similar to that described for the warmer sites.

Tree succession is simplified because only *Pinus contorta* and *Abies lasiocarpa* are capable of becoming dominant. *Pinus contorta* forms the regeneration layer and it dominates the overstory until about 200 years after wildfire, when much of it has become scenescent (often hastened by dwarfmistletoe or mountain pine beetle attacks) and its stands break up, allowing the shade-tolerant *Abies* to ascend from its understory position.

SPECIES RESPONSE TO TREATMENT

In order to evaluate the response of each species of undergrowth plant to treatment, all treated plots were compared individually with their untreated "control." Canopy coverages for each species were listed side by side for all the untreated and treated plots having a given treatment type and similar age-since-treatment (Appendix A). These data were then inspected to identify plants that generally increased ("i" and "I" in Table 4) after a certain type of treatment as well as those that generally decreased ("d" and "D") and those that had little or inconsistent change in coverage ("lc" and "LC"). Species shown with capital letters in Table 4 were major components of at least half of either the untreated or the treated stands in that category. Underlining signifies that the species strongly increased or strongly decreased in coverage.

Each of the interpreted species responses shown in Table 4 is based upon the stand data arranged for inspection in Appendix A. A similar presentation of species response data for our 1977 sample stands in the *Pseudotsuga/Physocarpus* h.t. is shown in Table 5, which is interpreted from the individual paired-stand data in Appendix B.

For example in interpreting species response to treatment, *Vaccinium globulare* (*VAGL*) is listed as a major undergrowth component that decreases strongly for the first 24 years after CCNP, CCMS, and CCBB treatments in the *PSME/VAGL* and *ABLA/XETE* h.t.s (Table 4). Examination of *VAGL* coverage on individual paired (untreated vs. treated) plots in Appendix A reveals that coverage declined on all but three of the 46 pairs in the treatments mentioned. Coincidentally, the three exceptions (on sites X-11 and X-24), were exceptionally moist sites for the *ABLA/XETE* habitat type (almost *ABLA/LIBO* h.t.). Further inspection of Table 4 and Appendix A shows that *VAGL* coverage also declined strongly on the youngest three WF stand pairs (sites X-22, X-21, and X-16--ages 17 to 24 years). However, in the remaining 21 WF pairs (a moist-site 24-year-old stand and stands 30 to 105 years old) *Vaccinium globulare* coverage showed little or variable change from that in untreated stands.

Xerophyllum coverage changed differentially by treatment type (Table 4 and Appendix A), being little affected by CCNP treatment, strongly decreasing after CCMS, and intermediately affected (generally decreasing) after CCBB and WF. Conversely, *Carex rossii* and *Anaphalis* increased most strongly after CCMS.

The sod-forming graminoids *Calamagrostis rubescens* and *Carex geyeri* generally increased during the first 24 years after CCNP, CCMS, and CCBB. Note how this contrasts with their response to similar treatments on the warmer *PSME/PHMA* h.t. (Table 5 and Appendix B). Sylvan herbs like *Arnica cordifolia* and *A. latifolia* and especially *Chimaphila umbellata*, *Goodyera oblongifolia*, and *Pyrola secunda* decrease strongly with overstory removal of any sort on *PSME/VAGL*, *ABLA/XETE*, or

PSME/PHMA h.t.s, but as the older WF pairs suggest, the herbs generally regain their original coverage after 40 to 60 years.

The *PSME/PHMA* h.t. data (Table 5) suggest that *Acer glabrum* is not shade intolerant. This agrees with Peter Stickney's findings (personal communication, USDA For. Serv., INT, Missoula). Thus, *Acer* should not have been grouped with *Amelanchier*, *Ceanothus*, and *Salix* as a member of the intolerant shrub group as was done in the 1978 Progress Report on this study.

Among all the species responses shown for the three habitat types, that of *Physocarpus* (Table 5) seems most unique. The coverage of this major component showed little or inconsistent change after all treatments.

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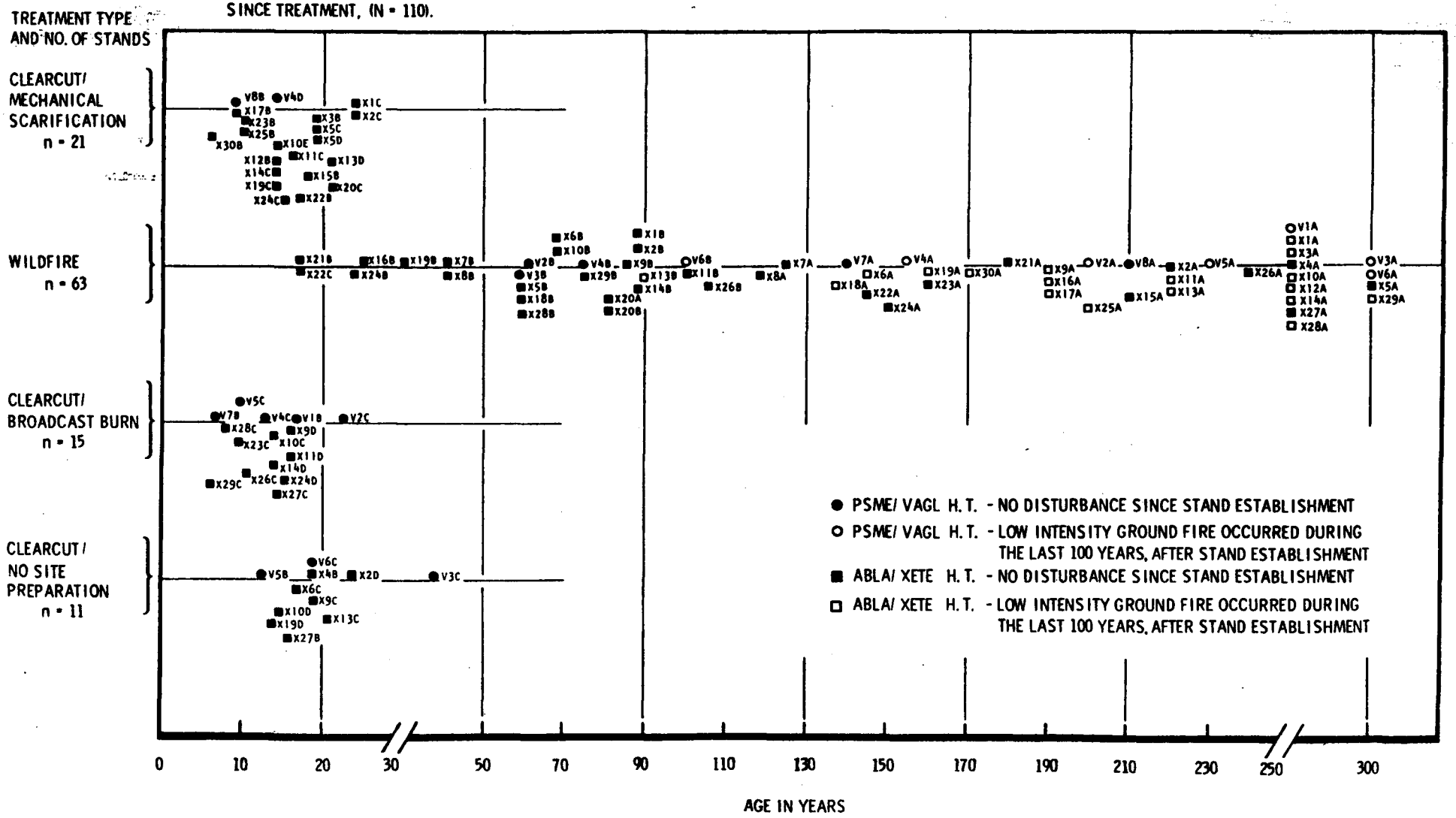
Fig. 1 — ABIES LASIOCARPA/ XEROPHYLLUM AND PSEUDOTSUGA/ VACCINIUM GLOBULARE HABITAT TYPE SAMPLE STANDS ARRANGED BY TREATMENT TYPE AND YEARS SINCE TREATMENT, (N = 110).


TREATMENT TYPE AND NO. OF STANDS
CLEARCUT/ MECHANICAL SCARIFICATION n = 21
WILDFIRE n = 63
CLEARCUT/ BROADCAST BURN n = 15
CLEARCUT/ NO SITE PREPARATION n = 11
● PSME/ VAGL H.T. - NO DISTURBANCE SINCE STAND ESTABLISHMENT
○ PSME/ VAGL H.T. - LOW INTENSITY GROUND FIRE OCCURRED DURING THE LAST 100 YEARS, AFTER STAND ESTABLISHMENT
■ ABLA/ XETE H.T. - NO DISTURBANCE SINCE STAND ESTABLISHMENT
□ ABLA/ XETE H.T. - LOW INTENSITY GROUND FIRE OCCURRED DURING THE LAST 100 YEARS, AFTER STAND ESTABLISHMENT
0 10 20 30 50 70 90 110 130 150 170 190 210 230 250 300
AGE IN YEARS

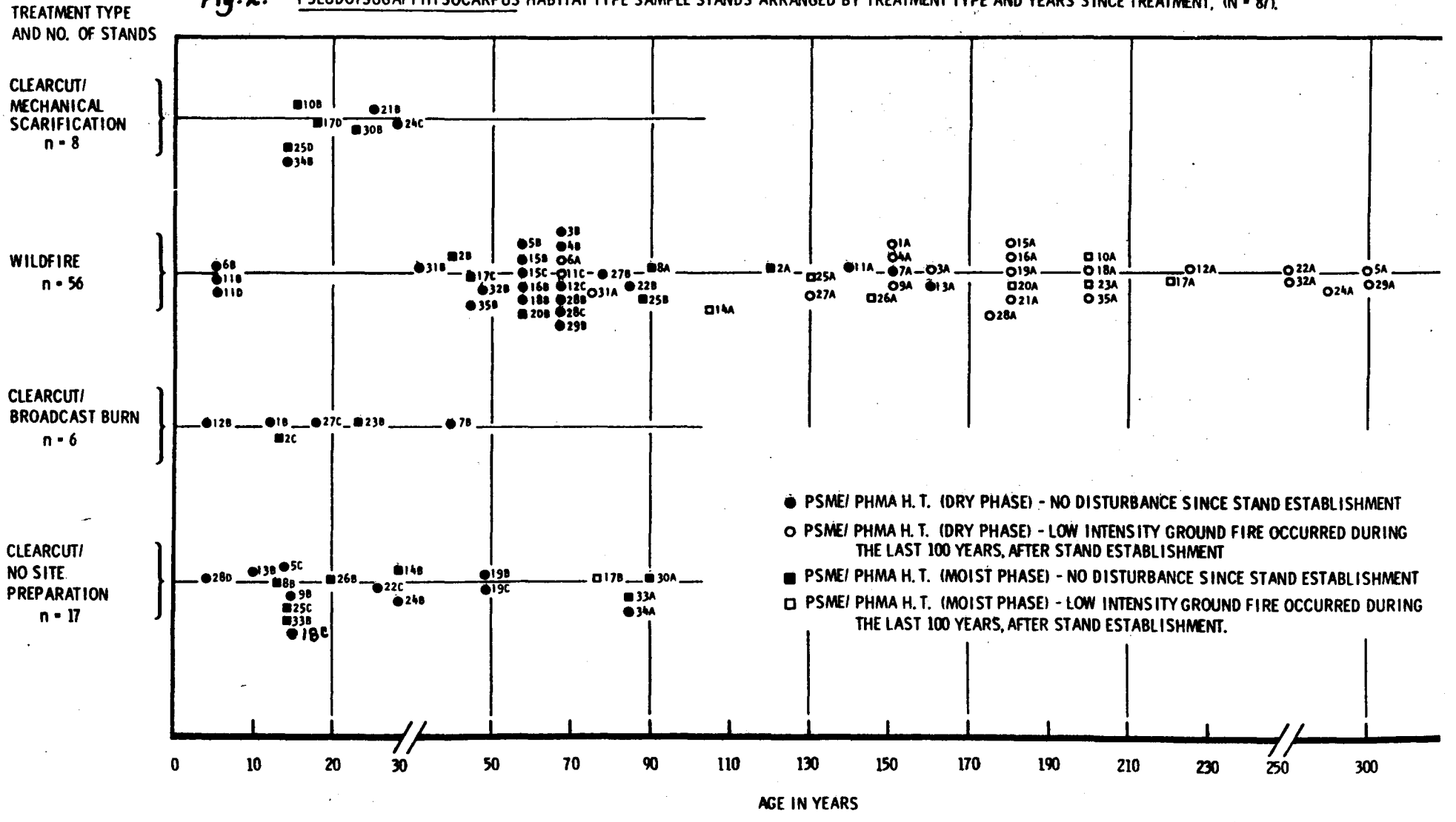
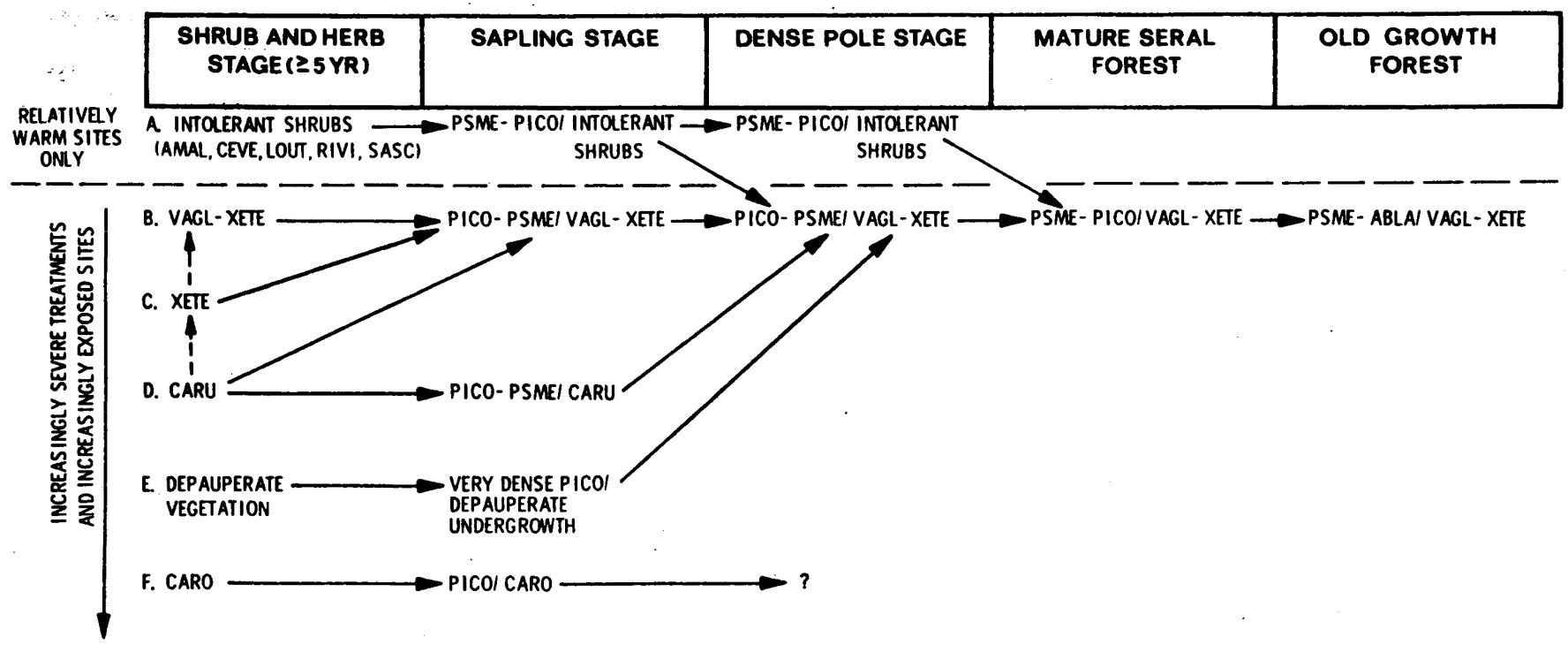

TREATMENT TYPE AND NO. OF STANDS
CLEARCUT/ MECHANICAL SCARIFICATION n = 8
WILDFIRE n = 56
CLEARCUT/ BROADCAST BURN n = 6
CLEARCUT/ NO SITE PREPARATION n = 17
● PSME/ PHMA H. T. (DRY PHASE) - NO DISTURBANCE SINCE STAND ESTABLISHMENT
○ PSME/ PHMA H. T. (DRY PHASE) - LOW INTENSITY GROUND FIRE OCCURRED DURING THE LAST 100 YEARS, AFTER STAND ESTABLISHMENT
■ PSME/ PHMA H. T. (MOIST PHASE) - NO DISTURBANCE SINCE STAND ESTABLISHMENT
□ PSME/ PHMA H. T. (MOIST PHASE) - LOW INTENSITY GROUND FIRE OCCURRED DURING THE LAST 100 YEARS, AFTER STAND ESTABLISHMENT.
0 10 20 30 50 70 90 110 130 150 170 190 210 230 250 300
AGE IN YEARS

Fig. 2. -- PSEUDOTSUGA/ PHYSOCARPUS HABITAT TYPE SAMPLE STANDS ARRANGED BY TREATMENT TYPE AND YEARS SINCE TREATMENT, (N = 87).

Fig. 3--

SUCCESSIONAL STAGES ON THE PSME/ VAGL H. T. AND ABLA/ XETE H. T., (WARM PHASE), IN WEST- CENTRAL MONTANA, BASED UPON A SAMPLE OF 25 SITES HAVING A TOTAL OF 76 PAIRED COMMUNITIES. (Arrows indicate apparent directions of succession. Dashed arrows are less common routes.)



Range of values from sample stands

	SHRUB AND HERB STAGE (≥5 YR)	SAPLING STAGE	DENSE POLE STAGE	MATURE SERAL FOREST	OLD GROWTH FOREST
TREE CANOPY COVERAGE	0 - 10%	10 - 50%	60 - 90%	45 - 70%	40 - 80%
DOMINANT TREE D.B.H.	0 - 2 IN	2 - 4 IN	4 - 10 IN	12 - 18 IN	14 - 24 IN
AGE	5 - 25 YRS	14 - 30 YRS	30 - 100 YRS	100 - 200 YRS	200 - 300 YRS

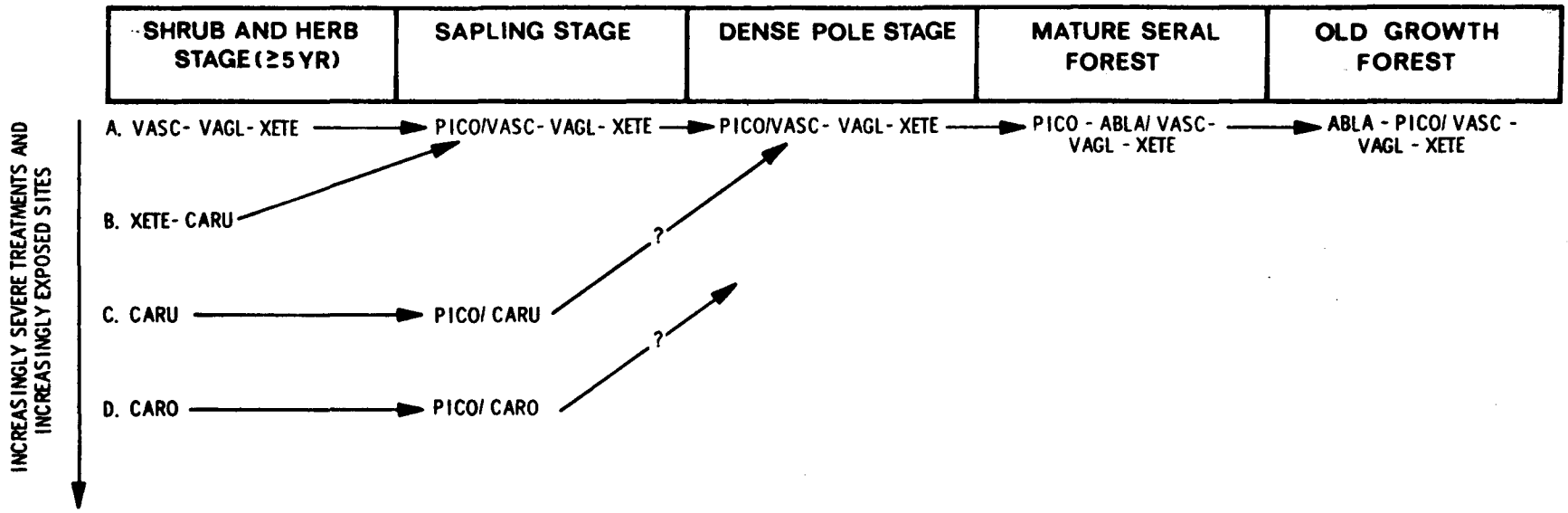
LEGEND:

TREES: ABLA- ABIES LASIOCARPA
PICO- PINUS CONTORTA
PSME- PSUEDOTSUGA MENZIESII

UNDERGROWTH: AMAL - AMELANCHIER ALNIFOLIA
CEVE - CEANOTHUS VELUTINUS
CARO - CAREX ROSSII
CARU - CALAMAGROSTIS RUBESCENS
VAGL - VACCINIUM GLOBULARE
XETE - XEROPHYLLUM TENAX
LOUT - LONICERA UTAHENSIS
RIVI - RIBES VISCOSISSIMUM
SASC - SALIX SCOULERIANA

Fig. 4 --

SUCCESSIONAL STAGES ON THE ABLA/ XETE H. T., (COLD PHASE), IN WEST-CENTRAL MONTANA, BASED UPON A SAMPLE OF 13 SITES HAVING A TOTAL OF 33 PAIRED COMMUNITIES.
(Arrows indicate apparent directions of succession. Dashed arrows are less common routes.)



	SHRUB AND HERB STAGE (≥5 YR)	SAPLING STAGE	DENSE POLE STAGE	MATURE SERAL FOREST	OLD GROWTH FOREST
Range of values from sample stands					
TREE CANOPY COVERAGE	0 - 10 %	10 - 50 %	55 - 90 %	35 - 65 %	40 - 80 %
DOMINANT TREE D.B.H.	0 - 2 IN	2 - 4 IN	5 - 10 IN	10 - 15 IN	12 - 14 IN
AGE	5 - 22 YRS	10 - 45 YRS	40 - 120 YRS	120 - 200 YRS	200 - 300 YRS

LEGEND:

TREES: ABLA - ABIES LASIOCARPA
PICO - PINUS CONTORTA

UNDERGROWTH: CARO - CAREX ROSSII
CARU - CALAMAGROSTIS RUBESCENS
VAGL - VACCINIUM GLOBULARE
VASC - VACCINIUM SCOPARIUM
XETE - XEROPHYLLUM TENAX

TABLE 1.--STRUCTURAL AND COMPOSITIONAL CHARACTERISTICS OF EACH PSME/VAGL AND ABLA/XETE H.T. STAND BY SUCCESSIONAL STAGE AND COMMUNITY TYPE (CF FIGS. 3&4)

SHRUB AND HERB STAGE (FIG. 3)

	INTOLERANT SHRUB C.T.								VAGL-CEVE C.T.		
HABITAT TYPE CODE	DF/VAGL	DF/VAGL	DF/VAGL	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	DF/VAGL	AF/XETE	AF/XETE
H.T. NUMBER	2	5	5	3	9	11	11	25	8	4	19
STAND NUMBER	3	2	3	2	3	3	4	2	2	2	3
TREATMENT CODE * (SEE FOOTNOTE)	BB	NP	BB	MS	NP	MS	BB	MS	MS	NP	MS
STAND AGE (YEARS)	23	13	10	19	19	16	16	10	9	19	14
YEARS SINCE GROUND FIRE	23	150	10	19	86	16	16	10	210	250	14
ASPECT (IN DEGREES)	190	144	140	62	155	15	355	233	275	85	165
ELEVATION (IN FEET)	5400	5800	5800	4900	6200	5900	5900	6100	5500	5900	6250
SLOPE (IN DEGREES)	18	30	25	32	30	19	19	18	14	35	19
PERCENT TREE CANOPY COVERAGE	2	1	0	6	2	1	1	1	3	0	1
DOMINANT TREE DBH (INCHES)	1	1	0	1	0	1	1	0	0	0	1
BASAL AREA (SQ FT/ACRE)	1	0	0	1	0	0	0	0	0	0	0
CURRENT STOCKING CODE **	1	0	0	1	0	1	1	1	2	0	0
NUMBER OF TIMES PLANTED	0	1	1	0	0	0	0	2	0	0	3
PERCENT BARE MINERAL SOIL	15	1	1	1	1	1	0	5	2	5	15
YEARS SINCE PLANTING											
PINUS PONDEROSA	0	0	0	0	0	0	0	0	0	0	2
PSEUDOTSUGA MENZIESII	0	0	0	0	0	0	0	2	0	0	12
PINUS CONTORTA	0	0	0	0	0	0	0	0	0	0	2
LARIX OCCIDENTALIS	0	0	0	0	0	0	0	0	0	0	0
PICEA ENGELMANNII	0	0	0	0	0	0	0	0	0	0	0
SPECIES UNKNOWN	0	9	9	0	0	0	0	0	0	0	0
PERCENT CANOPY COVERAGE FOR INDIVIDUAL TREE SPECIES (OVERSTORY/UNDERSTORY)											
PINUS PONDEROSA ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PINUS PONDEROSA <4 IN DBH	.3	0	.5	.5	0	0	0	.5	0	0	.5
PSEUDOTSUGA MENZIESII ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII <4 IN DBH	1.0	.5	.2	4.0	.5	.5	.5	.5	.5	0	.5
PINUS CONTORTA ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PINUS CONTORTA <4 IN DBH	.3	.5	.2	.5	.5	0	0	1.0	2.0	.5	2.0
LARIX OCCIDENTALIS ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
LARIX OCCIDENTALIS <4 IN DBH	0	0	0	.2	0	.5	.5	0	0	0	.5
ABIES LASIOCARPA ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
ABIES LASIOCARPA <4 IN DBH	0	0	0	0	.5	.5	.2	.5	0	.5	0
PICEA ENGELMANNII ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PICEA ENGELMANNII <4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PINUS ALBICAULIS ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PINUS ALBICAULIS <4 IN DBH	0	.5	0	0	0	0	0	0	0	0	0
PERCENT CANOPY COVERAGE FOR INDIVIDUAL UNDERGROWTH SPECIES											
105 AMELANCHIE ALNIFOLIA	.5	37.5	3.0	15.0	4.0	0	0	0	0	.5	0
107 CEANOTHUS VELUTINUS	15.0	0	.5	22.0	0	0	.5	22.0	0	0	0
115 LONICERA UTAHENSIS	0	3.0	4.0	.5	4.0	.5	8.0	0	0	0	0
119 PACHISTIMA MYRSINITES	0	0	0	0	0	0	0	0	.5	0	0
131 RIBES VISCOSISSI	0	0	0	0	.5	45.0	37.5	0	.2	0	.5
137 SALIX SCOULERIAN	.2	.5	.5	2.0	.5	1.0	.5	.5	1.0	0	3.0
142 SPIRAEA BETULIFOLI	1.0	.5	3.0	37.5	2.0	0	0	15.0	.5	.5	.5
146 VACCINIUM GLOBULARE	24.0	.5	.5	9.0	28.0	15.0	37.5	8.0	8.0	46.0	22.0
144 VACCINIUM SCOPARIUM	0	.5	.5	0	0	0	0	0	.5	.5	0
201 ARCTOSTAPH UVA-URSI	37.5	37.5	15.0	0	.2	0	0	0	.5	0	0
203 BERBERIS AFPENS	0	.5	.5	.5	.5	0	0	0	0	0	0
307 CALAMAGROS RUBESCENS	15.0	37.5	46.0	15.0	22.0	.5	3.0	46.0	3.0	3.0	62.5
308 CAREX CONCINNOID	.5	.5	.5	0	.5	3.0	8.0	.5	8.0	.5	.5
309 CAREX GEYERI	3.0	15.0	.5	37.5	22.0	3.0	.5	8.0	.5	8.0	8.0
311 CAREX ROSSII	.5	0	.5	0	0	3.0	.5	0	2.0	.5	0
401 ACHILLEA MILLEFOLIU	0	0	.5	.5	.5	.5	.5	0	.5	.5	.5
405 ANAPHALIS MARGARITAC	0	0	0	0	0	.5	0	0	.5	0	0
413 ANTENNARIA RACEMOSA	.5	0	0	2.0	.5	15.0	.5	0	8.0	.5	0
422 ARNICA LATIFOLIA	0	0	0	0	0	15.0	3.0	0	.5	.5	.5
426 ASTER CONSPICUUS	0	0	0	8.0	.5	0	0	0	0	0	0
442 CHIMAPHILA UMBELLATA	0	0	0	0	0	0	0	0	.5	0	0
459 EPILOBIUM ANGUSTIFOL	0	0	.5	0	2.0	.5	.5	.5	.5	0	.5
466 FRAGARIA VIRGINIANA	0	0	0	.5	.5	3.0	.5	0	.5	0	0
476 GOODYERA OBLONGIFOL	0	0	0	.5	0	0	0	0	.5	0	0
480 HEDYSARUM OCCIDENTAL	0	.5	15.0	0	.5	0	0	0	0	0	0
486 HIERACIUM ALBIFLORUM	.5	.5	0	0	.5	.5	.5	0	.5	0	0
509 PEDICULARI RACEMOSA	0	0	0	0	0	0	0	0	.5	0	0
510 PENSTEMON ALBERTINUS	5.0	.5	.5	0	.5	0	0	0	.5	.5	0
529 PYROLA SECUNDA	0	0	0	0	0	0	.5	0	.5	0	0
547 THALICTRUM OCCIDENTAL	0	0	0	3.0	.5	.5	3.0	0	0	0	.5
559 XEROPHYLLU TENAX	25.0	8.0	3.0	8.0	46.0	.5	3.0	3.0	2.0	62.5	4.0

* KEY TO TREATMENT CODES

CO = CONTROL (OLD GROWTH STAND)
NP = CLEARCUT WITH NO SITE PREPARATION
BB = CLEARCUT FOLLOWED BY BROADCAST BURNING
MS = CLEARCUT FOLLOWED BY MECHANICAL SCARIFICATION

** KEY TO CURRENT STOCKING CODE

0 = INADEQUATE STOCKING
1 = MARGINALLY ADEQUATE STOCKING
2 = ADEQUATE STOCKING

	VAGL-XETE C.T.			XETE C.T.					CARU C.T.		
HABITAT TYPE CODE	AF/XETE	AF/XETE	AF/XETE	DF/VAGL	AF/XETE	AF/XETE	AF/XETE	AF/XETE	DF/VAGL	DF/VAGL	DF/VAGL
SITE NUMBER	19	24	26	4	10	27	28	29	4	6	7
STAND NUMBER	4	3	3	3	4	2	3	3	4	3	2
TREATMENT CODE * (SEE FOOTNOTE)	BB	NS	BB	BB	NP	NP	BB	BB	NS	NP	BB
STAND AGE (YEARS)	14	15	11	13	15	16	8	6	13	19	8
YEARS SINCE GROUND FIRE	14	15	11	13	68	250	8	6	13	68	8
ASPECT (IN DEGREES)	148	185	148	272	280	198	222	130	272	124	175
ELEVATION (IN FEET)	6250	5950	5900	6000	6600	6650	5600	6550	6800	5850	6150
SLOPE (IN DEGREES)	19	18	27	25	25	22	16	14	25	30	15
PERCENT TREE CANOPY COVERAGE	1	2	0	0	0	0	2	0	1	1	1
DOMINANT TREE DBH (INCHES)	1	1	0	0	0	0	1	0	0	1	0
BASAL AREA (SQ FT/ACRE)	0	2	0	0	0	0	0	0	0	0	0
CURRENT STOCKING CODE **	0	1	0	0	0	0	2	0	1	0	1
NUMBER OF TIMES PLANTED	3	0	0	4	0	0	1	1	4	0	1
PERCENT BARE MINERAL SOIL	2	5	15	1	0	1	10	2	3	1	15
YEARS SINCE PLANTING											
PINUS PONDEROSA	2	0	0	3	0	0	0	0	3	0	0
PSEUDOTSUGA MENZIESII	12	0	0	6	0	0	18	0	6	0	0
PINUS CONTORTA	2	0	0	3	0	0	70	0	3	0	0
LARIX OCCIDENTALIS	0	0	0	0	0	0	7	0	0	0	0
PICEA ENGELMANNII	0	0	0	0	0	0	0	0	0	0	0
SPECIES UNKNOWN	0	0	0	0	0	0	0	5	0	0	6
PERCENT CANOPY COVERAGE FOR INDIVIDUAL TREE SPECIES (OVERSTORY/UNDERSTORY)											
PINUS PONDEROSA ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PINUS PONDEROSA <4 IN DBH	.5	.2	0	0	0	0	0	0	0	.5	0
PSEUDOTSUGA MENZIESII ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII <4 IN DBH	.5	0	.5	.5	0	.5	3.0	.5	1.0	1.0	.5
PINUS CONTORTA ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PINUS CONTORTA <4 IN DBH	.5	0	0	.5	0	0	.5	.5	.5	0	.5
LARIX OCCIDENTALIS ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
LARIX OCCIDENTALIS <4 IN DBH	.5	.5	0	0	0	0	0	0	0	0	0
ABIES LASIOCARPA ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
ABIES LASIOCARPA <4 IN DBH	.5	.5	0	0	0	.2	.5	0	0	0	0
PICEA ENGELMANNII ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PICEA ENGELMANNII <4 IN DBH	0	.5	0	0	0	0	0	0	0	0	0
PINUS ALBICAULIS ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PINUS ALBICAULIS <4 IN DBH	0	0	0	0	0	.2	0	0	0	0	0
PERCENT CANOPY COVERAGE FOR INDIVIDUAL UNDERGROWTH SPECIES											
105 AMELANCHIE ALNIFOLIA	.2	0	0	0	0	3.0	.5	0	0	2.0	.5
107 CEANOTHUS VELUTINUS	.2	0	.5	0	0	0	2.0	0	0	4.0	0
115 LONICERA UTAHENSIS	0	0	0	.5	0	.5	0	.5	0	0	.5
118 PACHISTIMA MYRSINITES	0	0	2.0	0	0	.5	8.0	0	0	0	0
131 RIBES VISCOSISSI	.5	.5	.5	1.0	.5	.5	.5	.5	1.0	0	.5
137 SALIX SCOULERIAN	0	.5	0	.5	0	0	.5	0	0	.5	0
142 SPIRAEA BETULIFOLI	2.0	1.0	3.0	.5	0	0	8.0	0	.5	15.0	.5
146 VACCINIUM GLOBULARE	22.0	37.5	22.0	0	.5	0	3.0	3.0	0	2.0	0
148 VACCINIUM SCOPARIUM	0	0	0	0	0	0	.5	.5	0	0	0
201 ARCTOSTAPH UVA-URSI	0	0	0	0	0	0	.5	0	0	0	0
203 BERBERIS REPENS	0	0	.2	.5	0	.5	0	.5	.5	.5	.5
307 CALAMAGROS RUBESCENS	62.5	0	.5	72.0	37.5	.5	3.0	46.0	46.0	54.0	62.5
308 CAREX CONCINNOID	.5	3.0	2.0	.5	0	0	.5	2.0	0	.5	0
309 CAREX GEYERI	37.5	0	2.0	15.0	15.0	62.5	8.0	15.0	3.0	37.5	2.0
311 CAREX ROSSII	0	15.0	2.0	.5	0	0	.5	.5	0	0	.5
401 ACHILLEA MILLEFOLIU	.5	.5	0	.5	.5	0	.5	.5	.5	.5	1.0
405 ANAPHALIS MARGARITAC	0	15.0	0	0	.5	0	.5	0	0	0	0
413 ANTENNARIA RACEMOSA	0	0	.5	0	0	.5	.5	.5	.5	0	.5
422 ARNICA LATIFOLIA	0	.5	.5	0	0	.5	0	.5	0	0	0
426 ASTER CONSPICUUS	0	0	0	22.0	0	0	0	3.0	37.5	0	.5
442 CHIMAPHILA UMBELLATA	0	0	0	0	0	0	0	0	0	0	0
459 EPILOBIUM ANGUSTIFOL	.5	3.0	.5	1.0	.5	22.0	.5	.5	1.0	.5	.5
466 FRAGARIA VIRGINIANA	0	.5	0	0	0	.5	.5	2.0	.5	0	3.0
476 GOODYERA OBLONGIFOL	0	0	0	0	0	0	0	0	0	0	0
488 HEDYSARUM OCCIDENTAL	0	0	0	0	.5	0	0	0	0	0	0
494 HIERACIUM ALBIFLORUM	0	.5	.5	0	.5	0	.5	.5	.5	0	0
509 PEDICULARI RACEMOSA	0	0	0	0	0	0	.5	0	0	0	0
510 PENSTEMON ALBERTINUS	0	.5	0	.5	0	0	0	.5	.5	0	0
529 PYROLA SECUNDA	0	0	0	0	0	0	0	0	0	0	0
547 THALICTRUM OCCIDENTAL	.5	0	0	.5	.5	3.0	0	0	3.0	0	0
559 XEROPHYLLU TENAX	29.0	15.0	46.0	29.0	54.0	37.5	54.0	15.0	.5	.5	2.0

* KEY TO TREATMENT CODES

CO = CONTROL (OLD GROWTH STAND)
NP = CLEARCUT WITH NO SITE PREPARATION
BB = CLEARCUT FOLLOWED BY BROADCAST BURNING
MS = CLEARCUT FOLLOWED BY MECHANICAL SCARIFICATION
WF = WILDFIRE

** KEY TO CURRENT STOCKING CODE

0 = INADEQUATE STOCKING
1 = NEARLY ADEQUATE STOCKING
2 = ADEQUATE STOCKING

	SHRUB AND HERB STAGE (FIG. 3)					SAPLING STAGE					
	CARU C.T.				CARO	DF-LP/INTOL. SHRUB			LP-DF/VAGL-XETE		
AT TYPE CODE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	DF/VAGL	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE
NUMBER	9	12	13	27	24	1	10	24	6	1	10
STAND NUMBER	4	2	3	3	4	2	5	2	3	3	3
TREATMENT CODE * (SEE FOOTNOTE)	BB	NS	NP	BB	BB	BB	NS	NP	NS	NS	BB
STAND AGE (YEARS)	16	13	21	14	15	17	14	25	17	24	14
YEARS SINCE GROUND FIRE	16	13	90	14	15	17	14	25	68	24	14
ASPECT (IN DEGREES)	140	260	88	186	180	225	190	215	130	250	195
ELEVATION (IN FEET)	6250	6200	5800	6600	5950	5500	6500	6000	5700	6000	6600
SLOPE (IN DEGREES)	23	18	20	27	18	25	20	20	18	13	20
PERCENT TREE CANOPY COVERAGE	0	1	3	1	7	15	20	50	30	35	15
DOMINANT TREE DBH (INCHES)	0	0	2	0	1	2	3	4	2	4	2
BASAL AREA (SQ FT/ACRE)	0	0	4	0	5	4	21	25	10	14	3
CURRENT STOCKING CODE **	0	0	1	0	2	2	2	2	2	2	2
NUMBER OF TIMES PLANTED	2	2	0	1	0	0	1	0	0	0	1
PERCENT BARE MINERAL SOIL	20	5	1	40	1	8	20	2	1	8	10
YEARS SINCE PLANTING											
PINUS PONDEROSA	12	0	0	0	0	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII	0	9	0	13	0	0	12	0	0	0	12
PINUS CONTORTA	0	0	0	0	0	0	0	0	0	0	0
LARIX OCCIDENTALIS	0	0	0	0	0	0	0	0	0	0	0
PICEA ENGELMANNII	0	0	0	0	0	0	0	0	0	0	0
SPECIES UNKNOWN	0	0	0	0	0	0	0	0	0	0	0
PERCENT CANOPY COVERAGE FOR INDIVIDUAL TREE SPECIES						(OVERSTORY/UNDERSTORY)					
PINUS PONDEROSA ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PINUS PONDEROSA <4 IN DBH	0	0	0	0	0	.2	0	.3	0	0	0
PSEUDOTSUGA MENZIESII ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII <4 IN DBH	.2	.5	3.0	.5	0	15.0	3.0	.5	3.0	3.0	.5
PINUS CONTORTA ≥4 IN DBH	0	0	0	0	0	0	0	.5	0	.5	0
PINUS CONTORTA <4 IN DBH	.2	.2	2.0	0	.5	.2	15.0	8.0	22.0	28.0	15.0
LARIX OCCIDENTALIS ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
LARIX OCCIDENTALIS <4 IN DBH	0	0	0	0	2.0	0	0	8.0	0	.2	0
ABIES LASIOCARPA ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
ABIES LASIOCARPA <4 IN DBH	0	0	.5	0	0	0	.5	3.0	0	.5	.5
PICEA ENGELMANNII ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PICEA ENGELMANNII <4 IN DBH	0	0	0	0	.5	0	0	8.0	0	0	.5
PINUS ALBICAULIS ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PINUS ALBICAULIS <4 IN DBH	0	0	0	0	0	.2	0	0	0	0	.5
PERCENT CANOPY COVERAGE FOR INDIVIDUAL UNDERGROWTH SPECIES											
105 AMELANCHIE ALNIFOLIA	2.0	0	0	1.0	0	22.0	0	.5	.5	0	0
107 CEANOTHUS VELUTINUS	4.0	0	0	.5	0	37.5	8.0	.5	0	.5	.2
115 LONICERA UTAHENSIS	0	.5	0	0	0	.5	0	0	0	0	0
119 PACHISTIMA MYRSINITES	0	0	0	0	0	0	0	0	0	0	0
131 RIBES VISCOSISSI	.2	.5	3.0	.5	.5	.5	.5	.5	.5	0	.5
137 SALIX SCOULERIAN	0	2.0	0	0	.5	.5	3.0	8.0	3.0	.5	.5
142 SPIRAEA BETULIFOLI	.5	2.0	0	0	.5	8.0	.5	3.0	22.0	3.0	.5
146 VACCINIUM GLOBULARE	.2	.5	4.0	0	3.0	3.0	3.0	37.5	22.0	8.0	3.0
149 VACCINIUM SCOPARIUM	0	0	0	0	0	0	0	0	0	22.0	0
201 ARCTOSTAPH UVA-URSI	.5	0	4.0	0	0	3.0	0	0	.5	.5	0
203 BERBERIS REPENS	.5	.5	0	1.0	0	.5	0	.5	.5	0	0
307 CALAMAGROS RUBESCENS	8.0	62.5	85.0	0	0	15.0	3.0	.5	72.0	15.0	22.0
305 CAREX CONCINNOID	0	.5	.5	0	2.0	.5	.5	2.0	.5	.5	.5
309 CAREX GEYERI	44.0	37.5	.5	17.5	0	.5	.5	.5	.5	0	.5
311 CAREX ROSSII	0	0	0	0	4.0	.5	.5	2.0	0	0	.5
401 ACHILLEA MILLEFOLIU	.5	.5	.5	.5	.5	.5	.5	.5	.5	0	.5
405 ANAPHALIS MARGARITAC	0	0	.5	0	15.0	0	.5	8.0	.5	0	.5
413 ANTENNARIA RACEMOSA	0	.5	.5	.5	0	0	0	.5	.5	0	0
422 ARNICA LATIFOLIA	0	0	.5	0	.5	0	.5	3.0	15.0	3.0	.5
426 ASTER CONSPICUUS	.5	2.0	.5	0	0	.5	0	0	15.0	0	0
442 CHIMAPHILA UMBELLATA	0	0	0	0	0	0	0	0	0	0	0
450 EPILOBIUM ANGUSTIFOL	.5	.5	.5	.5	22.0	.5	.5	3.0	.5	.5	.5
466 FRAGARIA VIRGINIANA	0	4.0	3.0	1.0	0	3.0	0	.5	.5	0	0
476 GOODYERA OBLONGIFOL	0	0	0	0	0	0	0	0	0	0	0
480 HEDYSARUM OCCIDENTAL	0	0	0	0	0	0	3.0	0	0	0	3.0
484 HIERACIUM ALBIFLORUM	.5	.5	.5	0	.5	0	.5	.5	.5	.5	.5
509 PEDICULARI RACEMOSA	0	0	0	0	0	0	0	0	0	0	0
510 PENSTEMON ALBERTINUS	.5	.5	0	0	0	0	.5	.5	0	0	0
529 PYROLA SECUNDA	0	0	0	0	0	0	0	0	0	0	0
547 THALICTRUM OCCIDENTAL	0	.5	.5	.5	0	.5	0	0	0	0	0
558 XEROPHYLLU TENAX	.5	.5	4.0	1.0	3.0	44.0	2.0	37.5	3.0	28.0	15.0

* KEY TO TREATMENT CODES

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BB = CLEARCUT FOLLOWED BY BROADCAST BURNING

** KEY TO CURRENT STOCKING CODE

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2 = ADEQUATE STOCKING

SAPLING STAGE (FIG. 3) | DENSE POLE STAGE

	LP-DF/CARU	V. DENSE LP		DF/LP/ INTOL. SHRUB	LP-DF/VAGL-XETE C.T.						
HABITAT TYPE CODE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	DF/VAGL	DF/VAGL	DF/VAGL	AF/XETE	AF/XETE	AF/XETE
SITE NUMBER	13	22	22	PA	19	3	3	2	6	10	29
STAND NUMBER	4	2	3	2	2	3	2	2	2	2	2
TREATMENT CODE * (SEE FOOTNOTE)	MS	MS	WF	WF	WF	NP	dF	dF	WF	WF	WF
STAND AGE (YEARS)	21	17	17	59	30	39	59	61	68	68	74
YEARS SINCE GROUND FIRE	90	17	17	59	30	59	59	61	68	68	74
ASPECT (IN DEGREES)	90	308	308	208	178	243	173	188	128	198	128
ELEVATION (IN FEET)	5400	6300	6300	5650	6400	5200	5150	5400	5700	6600	6950
SLOPE (IN DEGREES)	19	6	5	15	19	20	22	17	25	21	15
PERCENT TREE CANOPY COVERAGE	20	70	75	90	85	70	70	60	80	90	80
DOMINANT TREE DBH (INCHES)	4	2	2	6	4	6	10	8	6	10	8
BASAL AREA (SQ FT/ACRE)	14	86	74	194	56	35	93	55	130	122	393
CURRENT STOCKING CODE **	2	2	2	2	2	2	2	2	2	2	2
NUMBER OF TIMES PLANTED	0	0	0	0	0	0	0	0	0	0	0
PERCENT BARE MINERAL SOIL	0	10	1	0	1	0	0	1	0	0	0
YEARS SINCE PLANTING											
PINUS PONDEROSA	0	0	0	0	0	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII	0	0	0	0	0	0	0	0	0	0	0
PINUS CONTORTA	0	0	0	0	0	0	0	0	0	0	0
LARIX OCCIDENTALIS	0	0	0	0	0	0	0	0	0	0	0
PICEA ENGELMANNII	0	0	0	0	0	0	0	0	0	0	0
SPECIES UNKNOWN	0	0	0	0	0	0	0	0	0	0	0

PERCENT CANOPY COVERAGE FOR INDIVIDUAL TREE SPECIES (OVERSTORY/UNDERSTORY)

PINUS PONDEROSA	>4 IN DBH	0	0	0	0	0	.5	3.2	.5	0	0	0
PINUS PONDEROSA	<4 IN DBH	0	0	0	0	0	.5	.5	.5	0	0	0
PSEUDOTSUGA MENZIESII	>4 IN DBH	0	0	0	3.0	0	37.5	48.5	.2	0	3.0	0
PSEUDOTSUGA MENZIESII	<4 IN DBH	3.0	0	0	37.5	3.0	37.5	3.0	4.0	.5	15.0	2.0
PINUS CONTORTA	>4 IN DBH	0	0	0	15.0	.5	0	0	37.5	37.5	62.5	37.5
PINUS CONTORTA	<4 IN DBH	15.0	62.5	78.0	15.0	72.0	.5	0	3.0	37.5	3.0	37.5
LARIX OCCIDENTALIS	>4 IN DBH	0	0	0	.5	0	.5	37.5	.2	0	0	0
LARIX OCCIDENTALIS	<4 IN DBH	.5	0	0	15.0	0	.5	.5	0	0	0	0
ABIES LASIOCARPA	>4 IN DBH	0	0	0	0	0	0	0	0	0	.5	0
ABIES LASIOCARPA	<4 IN DBH	0	.5	0	.5	.5	0	0	0	0	.5	0
PICEA ENGELMANNII	>4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PICEA ENGELMANNII	<4 IN DBH	0	0	0	0	0	0	0	0	0	.5	0
PINUS ALBICAULIS	>4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PINUS ALBICAULIS	<4 IN DBH	0	0	0	0	0	0	0	0	0	0	0

PERCENT CANOPY COVERAGE FOR INDIVIDUAL UNDERGROWTH SPECIES

105	AMELANCHIE	ALNIFOLIA	0	0	0	0	0	.5	.5	.5	.5	0	0
107	CEANOTHUS	VELUTINUS	0	0	0	0	0	0	0	.5	0	0	0
115	LONICERA	UTAHENSIS	0	.5	0	0	0	0	0	0	.5	0	0
119	PACHISTIMA	MYRSINITES	0	0	0	P2.0	0	0	0	0	0	0	0
131	RIBES	VISCOSISSI	.5	0	0	.5	.5	0	0	0	0	0	0
137	SALIX	SCOULERIAN	.5	.5	.5	P2.0	.5	4.0	3.0	3.0	2.0	.5	0
142	SPIRAEA	BETULIFOLI	0	15.0	4.0	3.0	.5	28.0	15.0	.5	3.0	.5	.5
146	VACCINIUM	GLOBULARE	15.0	8.0	.5	1.0	54.0	62.5	37.5	37.5	46.0	46.0	15.0
148	VACCINIUM	SCOPARIUM	.5	3.0	4.0	0	0	0	0	0	0	3.0	15.0
201	ARCTOSTAPH	UVA-URSI	28.0	15.0	.5	.5	0	3.0	.5	3.0	.5	0	0
203	BERBERIS	REPENS	0	0	0	0	0	15.0	4.0	.5	.5	0	.5
307	CALAMAGROS	RUBESCENS	85.0	15.0	8.0	.5	28.0	94.0	62.5	22.0	3.0	.5	8.0
308	CAREX	CONCINNOID	.5	2.0	.5	.5	.5	.5	0	.5	.5	.5	.5
309	CAREX	GEYERI	.5	0	0	.5	.5	0	.5	0	0	.5	.5
311	CAREX	ROSSII	0	.5	.5	0	0	0	0	0	0	0	0
401	ACHILLEA	MILLEFOLIU	.5	.5	.5	0	0	0	0	0	0	0	0
405	ANAPHALIS	MARGARITAC	.5	.5	0	0	0	0	0	0	0	0	0
413	ANTENNARIA	RACEMOSA	.5	0	0	0	0	0	0	.5	0	.5	.5
422	ARNICA	LATIFOLIA	.5	0	.5	3.0	3.0	0	0	0	54.0	8.0	37.5
426	ASTER	CONSPICUUS	28.0	.5	.5	0	0	0	0	0	.5	0	.5
442	CHIMAPHILA	UMBELLATA	0	0	0	.5	.5	.5	.5	.5	.5	.5	.5
459	EPILOBIUM	ANGUSTIFOL	.5	.5	.5	0	.5	.5	.5	.5	.5	0	0
466	FRAGARIA	VIRGINIANA	1.0	0	0	0	0	.5	.5	0	0	0	.5
476	GOODYERA	OBLONGIFOL	0	0	0	.5	0	0	0	.5	.5	.5	0
480	HEDYSARUM	OCCIDENTAL	-0	0	0	0	0	0	0	0	.5	.5	0
486	HIERACIUM	ALBIFLORUM	.5	.5	0	.5	.5	0	.5	.5	.5	.5	.5
509	PEDICULARI	RACEMOSA	-0	0	0	0	0	0	0	0	.5	.5	0
510	PENSTEMON	ALBERTINUS	.5	0	0	0	0	0	0	0	0	0	0
529	PYROLA	SECUNDA	-0	0	0	.5	0	.5	.5	0	0	.5	0
547	THALICTRUM	OCCIDENTAL	-0	0	0	0	0	0	0	0	0	0	.5
558	XEROPHYLLU	TENAX	.5	.5	.5	P2.0	8.0	.5	.5	37.5	8.0	37.5	37.5

* KEY TO TREATMENT CODES

CO = CONTROL (OLD GROWTH STAND)
NP = CLEARCUT WITH NO SITE PREPARATION
BB = CLEARCUT FOLLOWED BY BROADCAST BURNING
MS = CLEARCUT FOLLOWED BY MECHANICAL SCARIFICATION
dF = WILDFIRE

** KEY TO CURRENT STOCKING CODE

0 = INADEQUATE STOCKING
1 = NEARLY ADEQUATE STOCKING
2 = ADEQUATE STOCKING

	DENSE POLE STAGE (FIG. 3)						MATURE SERAL FOREST				
	LP-DF/VAGL-XETE C.T.						DF-LP/VAGL-XETE C.T.				
STAT TYPE CODE	DF/VAGL	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	DF/VAGL	DF/VAGL	AF/XETE	DF/VAGL	AF/XETE
E NUMBER	4	9	13	26	11	1	6	7	24	4	6
STAND NUMBER	2	2	2	2	2	2	2	1	1	1	1
TREATMENT CODE * (SEE FOOTNOTE)	WF	WF	CO	WF	WF	CO	WF	CO	CO	CO	CO
STAND AGE (YEARS)	75	86	90	105	100	88	100	140	150	155	145
YEARS SINCE GROUND FIRE	75	86	90	105	100	88	68	140	150	75	68
ASPECT (IN DEGREES)	275	156	85	146	340	265	122	190	207	270	112
ELEVATION (IN FEET)	6400	6200	5800	5900	5850	6000	5700	6150	6000	6000	5700
SLOPE (IN DEGREES)	21	27	10	26	22	16	25	15	19	24	16
PERCENT TREE CANOPY COVERAGE	85	70	85	65	90	75	72	60	70	70	55
DOMINANT TREE DBH (INCHES)	8	9	9	10	8	8	14	16	14	18	12
BASAL AREA (SQ FT/ACRE)	226	119	321	131	155	169	189	192	294	260	171
CURRENT STOCKING CODE **	2	2	2	2	2	2	2	2	2	2	2
NUMBER OF TIMES PLANTED	0	0	0	0	0	0	0	0	0	0	0
PERCENT BARE MINERAL SOIL	0	0	0	0	0	0	0	0	1	0	0
YEARS SINCE PLANTING											
PINUS PONDEROSA	0	0	0	0	0	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII	0	0	0	0	0	0	0	0	0	0	0
PINUS CONTORTA	0	0	0	0	0	0	0	0	0	0	0
LARIX OCCIDENTALIS	0	0	0	0	0	0	0	0	0	0	0
PICEA ENGELMANNII	0	0	0	0	0	0	0	0	0	0	0
SPECIES UNKNOWN	0	0	0	0	0	0	0	0	0	0	0

PERCENT CANOPY COVERAGE FOR INDIVIDUAL TREE SPECIES (OVERSTORY/UNDERSTORY)

PINUS PONDEROSA	≥4 IN DBH	0	0	0	0	0	0	15.0	0	0	0	0
PINUS PONDEROSA	<4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII	≥4 IN DBH	15.0	3.0	15.0	3.2	37.5	3.2	52.5	18.0	10.0	70.5	15.2
PSEUDOTSUGA MENZIESII	<4 IN DBH	15.0	3.0	15.0	4.0	20.0	3.0	3.0	.5	.5	.5	3.0
PINUS CONTORTA	≥4 IN DBH	37.5	62.5	40.5	54.0	15.0	62.5	3.0	15.0	.2	.2	52.5
PINUS CONTORTA	<4 IN DBH	15.0	3.0	.5	.5	.5	8.0	.5	.5	0	.5	.5
LARIX OCCIDENTALIS	≥4 IN DBH	0	0	3.0	0	3.0	.4	0	0	3.0	0	0
LARIX OCCIDENTALIS	<4 IN DBH	0	0	.5	0	.5	0	0	0	0	0	0
ABIES LASIOCARPA	≥4 IN DBH	0	0	.5	.2	.2	.2	0	0	40.5	0	.2
ABIES LASIOCARPA	<4 IN DBH	0	.2	0	.5	.5	.5	0	0	8.0	0	.2
PICEA ENGELMANNII	≥4 IN DBH	0	0	0	0	0	0	0	0	16.0	0	0
PICEA ENGELMANNII	<4 IN DBH	0	0	.5	0	0	0	0	0	.5	0	0
PINUS ALBICAULIS	≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PINUS ALBICAULIS	<4 IN DBH	0	0	0	0	0	0	0	0	0	0	0

PERCENT CANOPY COVERAGE FOR INDIVIDUAL UNDERGROWTH SPECIES

105	AMELANCHIE	ALNIFOLIA	0	.5	0	0	0	0	.5	.5	.5	0	3.0
107	CEANOTHUS	VELUTINUS	0	0	0	0	0	0	0	0	0	0	0
115	LONICERA	UTAHENSIS	0	.5	0	0	.5	0	0	.5	0	.5	0
118	PACHISTIMA	MYRSINITES	0	0	0	8.0	0	0	0	0	0	0	0
131	RIBES	VISCOSISSI	.5	0	0	0	0	0	0	0	0	.5	0
137	SALIX	SCOULERIAN	0	0	.5	.5	.5	.5	2.0	0	0	0	.2
142	SPIRAEA	BETULIFOLI	.5	.5	0	.5	0	3.0	4.0	0	.5	.5	8.0
146	VACCINIUM	GLOBULARE	.5	46.0	8.0	72.0	4.0	62.5	22.0	.5	37.5	.5	85.0
148	VACCINIUM	SCOPARIUM	.5	0	.5	0	0	4.0	0	0	0	0	0
201	ARCTOSTAPH	UVA-URSI	0	0	.5	0	0	3.0	0	0	0	0	0
203	BERBERIS	REPENS	.5	.5	0	0	0	0	.5	.5	.5	.5	.5
307	CALAMAGROS	RUBESCENS	3.0	3.0	54.0	.5	2.0	.5	15.0	22.0	0	3.0	15.0
308	CAREX	CONCINNOID	.5	.5	.5	.5	.5	.5	.5	0	0	.5	.5
309	CAREX	GEYERI	.5	15.0	.5	.5	.5	0	.5	.5	0	3.0	.5
311	CAREX	ROSSII	0	0	0	0	0	0	0	0	0	0	0
401	ACHILLEA	MILLEFOLIU	0	0	0	0	0	0	0	0	0	0	0
405	ANAPHALIS	MARGARITAC	0	0	0	0	0	0	0	0	0	0	0
413	ANTENNARIA	RACEMOSA	.5	0	.5	.5	3.0	0	0	3.0	0	.5	0
422	ARNICA	LATIFOLIA	15.0	.5	.5	15.0	22.0	15.0	0	.5	.5	3.0	46.0
426	ASTER	CONSPICUUS	8.0	0	.5	0	0	0	0	.5	0	15.0	.5
442	CHIMAPHILA	UMBELLATA	0	.5	.5	3.0	0	2.0	8.0	3.0	.5	0	3.0
459	EPILOBIUM	ANGUSTIFOL	.5	.5	.5	0	0	0	.5	0	0	.5	.5
466	FRASARIA	VIRGINIANA	.5	.5	.5	0	.5	0	0	3.0	0	0	0
476	GOODYERA	OBLONGIFOL	.5	0	.5	.5	.5	.5	.5	.5	.5	.5	.5
480	MEDYSARUM	OCCIDENTAL	0	0	.5	0	0	0	0	0	0	0	.5
484	HIERACIUM	ALBIFLORUM	.5	0	.5	.5	.5	0	0	.5	0	0	.5
509	PEDICULARI	RACEMOSA	.5	0	0	.5	.5	.5	0	0	0	.5	0
510	PENSTEMON	ALBERTINUS	0	0	0	0	0	0	0	0	0	0	0
529	PYROLA	SECUNDA	.5	0	0	0	.5	0	.5	.5	.5	.5	0
547	THALICTRUM	OCCIDENTAL	.5	0	.5	0	.5	0	0	.5	0	15.0	.5
558	XEROPHYLLU	TENAX	62.5	62.5	37.5	72.0	62.5	62.5	.5	46.0	72.0	37.5	3.0

* KEY TO TREATMENT CODES

CO = CONTROL (OLD GROWTH STAND)
WP = CLEARCUT WITH WD SITE PREPARATION
BB = CLEARCUT FOLLOWED BY BROADCAST BURNING

** KEY TO CURRENT STOCKING CODE

0 = INADEQUATE STOCKING
1 = NEARLY ADEQUATE STOCKING
2 = ADEQUATE STOCKING

MATURE SERAL FOREST (FIG. 3)

OLD GROWTH FOREST

	DF-LP/VAGL-XETE C.T.					DF-AF/VAGL-XETE C.T.					
HABITAT TYPE CODE	AF/XETE	AF/XETE	AF/XETE	DF/VAGL	AF/XETE	DF/VAGL	AF/XETE	AF/XETE	DF/VAGL	AF/XETE	DF/VAGL
SITE NUMBER	22	19	9	2	25	8	11	13	5	26	1
STAND NUMBER	1	1	1	1	1	1	1	1	1	1	1
TREATMENT CODE * (SEE FOOTNOTE)	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO
STAND AGE (YEARS)	145	160	190	200	200	210	220	220	230	240	250
YEARS SINCE GROUND FIRE	145	80	86	61	130	210	100	90	150	240	100
ASPECT (IN DEGREES)	308	165	155	188	245	282	15	95	140	142	225
ELEVATION (IN FEET)	6300	6200	6200	5400	6100	5500	5900	5800	5850	5900	5500
SLOPE (IN DEGREES)	10	25	31	16	20	13	22	20	25	20	25
PERCENT TREE CANOPY COVERAGE	60	60	50	45	50	55	90	60	60	65	45
DOMINANT TREE DBH (INCHES)	12	16	17	14	12	12	22	16	16	16	14
BASAL AREA (SQ FT/ACRE)	119	199	184	159	220	272	387	240	159	241	161
CURRENT STOCKING CODE **	2	2	2	2	2	2	2	2	2	2	2
NUMBER OF TIMES PLANTED	0	0	0	0	0	0	0	0	0	0	0
PERCENT BARE MINERAL SOIL	0	0	1	0	0	0	0	0	0	1	1
YEARS SINCE PLANTING											
PINUS PONDEROSA	0	0	0	0	0	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII	0	0	0	0	0	0	0	0	0	0	0
PINUS CONTORTA	0	0	0	0	0	0	0	0	0	0	0
LARIX OCCIDENTALIS	0	0	0	0	0	0	0	0	0	0	0
PICEA ENGELMANNII	0	0	0	0	0	0	0	0	0	0	0
SPECIES UNKNOWN	0	0	0	0	0	0	0	0	0	0	0

PERCENT CANOPY COVERAGE FOR INDIVIDUAL TREE SPECIES (OVERSTORY/UNDERSTORY)

PINUS PONDEROSA	≥4 IN DBH	0	.2	3.5	18.0	0	0	0	.5	.2	0	3.5
PINUS PONDEROSA	<4 IN DBH	0	0	0	.5	0	0	0	.5	0	0	0
PSEUDOTSUGA MENZIESII	≥4 IN DBH	.7	65.5	30.0	78.0	15.5	30.0	38.0	30.0	41.5	36.0	23.0
PSEUDOTSUGA MENZIESII	<4 IN DBH	22.0	3.0	.5	.5	.5	2.0	.5	3.0	.5	.5	.5
PINUS CONTORTA	≥4 IN DBH	11.0	.5	.5	0	37.5	6.0	0	0	15.0	.2	.5
PINUS CONTORTA	<4 IN DBH	15.0	.5	0	.5	.5	0	0	0	2.0	0	0
LARIX OCCIDENTALIS	≥4 IN DBH	0	0	0	0	0	0	3.0	28.5	0	.5	0
LARIX OCCIDENTALIS	<4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
ABIES LASIOCARPA	≥4 IN DBH	.4	.5	.2	0	.2	0	15.0	.5	0	15.0	0
ABIES LASIOCARPA	<4 IN DBH	.5	.5	.2	0	.5	0	37.5	.5	.5	28.0	0
PICEA ENGELMANNII	≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PICEA ENGELMANNII	<4 IN DBH	0	0	0	0	0	0	0	0	0	.5	0
PINUS ALBICAULIS	≥4 IN DBH	0	0	0	0	.5	0	0	0	0	0	0
PINUS ALBICAULIS	<4 IN DBH	.5	.2	0	0	.5	0	0	0	.5	0	0

PERCENT CANOPY COVERAGE FOR INDIVIDUAL UNDERGROWTH SPECIES

105	AMELANCHIE	ALNIFOLIA	.5	0	.5	.5	0	0	0	0	4.0	.5	3.0
107	CEANOTHUS	VELUTINUS	0	0	0	0	.5	0	0	0	0	0	.5
115	LONICERA	UTAHENSIS	.5	0	.5	0	0	.2	.5	0	0	.5	0
118	PACHISTIMA	MYRSINITES	0	0	0	0	0	2.0	0	0	0	8.0	0
131	RIBES	VISCOSISSI	0	.2	.2	0	0	0	.5	0	0	0	.5
137	SALIX	SCOULERIAN	.5	.2	0	0	.5	0	0	0	0	0	.5
142	SPIRAEA	BETULIFOLI	.5	.5	.5	.5	3.0	.5	0	.5	3.0	.5	3.0
146	VACCINIUM	GLOBULARE	37.5	54.0	72.0	37.5	37.5	62.5	3.0	37.5	62.5	37.5	15.0
148	VACCINIUM	SCOPARIUM	62.5	0	0	0	0	.5	0	0	0	0	0
201	ARCTOSTAPH	UVA-URSI	0	0	0	46.0	0	8.0	0	.5	3.0	0	0
203	BERBERIS	REPENS	0	.5	.5	.5	.5	.5	0	.5	.5	.5	.5
307	CALAMAGROS	RUBESCENS	37.5	22.0	8.0	17.5	3.0	3.0	3.0	54.0	62.5	.5	15.0
308	CAREX	CONCINNOID	.5	.5	.5	.5	.5	.5	.5	.5	.5	2.0	3.0
309	CAREX	GEYERI	3.0	8.0	22.0	.5	.5	.5	.5	.5	.5	.5	.5
311	CAREX	ROSSII	0	0	0	0	0	.5	0	0	.5	.5	.5
401	ACHILLEA	MILLEFOLIU	0	.5	.5	0	0	0	0	0	0	0	0
405	ANAPHALIS	MARGARITAC	0	0	0	0	0	0	0	0	0	0	0
413	ANTENNARIA	RACEMOSA	.5	.5	.5	.5	0	2.0	.5	.5	3.0	0	3.0
422	ARNICA	LATIFOLIA	0	.5	0	0	0	3.0	37.5	22.0	0	15.0	0
426	ASTER	CONSPICUUS	0	0	0	0	0	0	0	.5	0	0	.5
442	CHIMAPHILA	UMBELLATA	.5	0	.5	.5	.5	8.0	.5	0	.5	.5	.5
459	EPILOBIUM	ANGUSTIFOL	0	0	.5	0	0	0	0	0	0	0	0
466	FRAGARIA	VIRGINIANA	0	0	0	0	0	.5	0	.5	0	0	0
476	GOODYERA	OBLONGIFOL	.5	0	.5	0	.5	.5	.5	.5	0	.5	0
480	HEDYSARUM	OCCIDENTAL	0	0	.5	0	0	0	0	.5	0	0	0
484	HIERACIUM	ALBIFLORUM	.5	0	.5	.5	0	.5	.5	.5	.5	.5	.5
589	PEDICULARI	RACEMOSA	.5	0	0	0	0	2.0	.5	.5	0	.5	.5
510	PENSTEMON	ALBERTINUS	0	0	.5	0	0	0	0	0	.5	0	0
529	PYROLA	SECUNDA	.5	.5	.2	0	.5	.5	.5	.5	0	.5	.5
547	THALICTRUM	OCCIDENTAL	0	2.0	0	0	0	0	15.0	0	0	0	3.0
558	XEROPHYLLU	TENAX	3.0	62.5	72.0	17.5	3.0	46.0	3.0	37.5	8.0	46.0	46.0

* KEY TO TREATMENT CODES

CO = CONTROL (OLD GROWTH STAND)
WP = CLEARCUT WITH NO SITE PREPARATION
BB = CLEARCUT FOLLOWED BY BROADCAST BURNING
MS = CLEARCUT FOLLOWED BY MECHANICAL SCARIFICATION
WF = WILDFIRE

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	OLD GROWTH FOREST (FIG. 3)									SHRUB-HERB STAGE (FIG. 4)
	DF-AF/VAGL-XETE C.T.									V-V-X C.T.
HABITAT TYPE CODE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	DF/VAGL	DF/VAGL	AF/XETE	AF/XETE	AF/XETE
PLOT NUMBER	3	4	10	12	27	28	3	6	29	1	15
STAND NUMBER	1	1	1	1	1	1	1	1	1	1	2
TREATMENT CODE * (SEE FOOTNOTE)	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	MS
STAND AGE (YEARS)	250	250	250	250	250	250	300	300	300	250	18
YEARS SINCE GROUND FIRE	100	250	60	100	250	150	59	100	74	80	18
ASPECT (IN DEGREES)	63	84	200	264	196	230	243	120	140	240	130
ELEVATION (IN FEET)	4900	5900	6600	6200	6700	5600	5150	5700	6550	6000	6200
SLOPE (IN DEGREES)	30	36	26	15	22	21	21	25	17	19	14
PERCENT TREE CANOPY COVERAGE	60	45	55	55	55	70	60	50	70	80	5
DOMINANT TREE DBH (INCHES)	16	14	24	17	20	17	18	20	19	14	2
BASAL AREA (SQ FT/ACRE)	239	140	333	144	327	293	228	169	261	175	5
CURRENT STOCKING CODE **	2	2	2	2	2	2	2	2	2	2	1
NUMBER OF TIMES PLANTED	0	0	0	0	0	0	0	0	0	0	1
PERCENT BARE MINERAL SOIL	0	1	1	0	0	0	1	1	0	0	5
YEARS SINCE PLANTING											
PINUS PONDEROSA	0	0	0	0	0	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII	0	0	0	0	0	0	0	0	0	0	0
PINUS CONTORTA	0	0	0	0	0	0	0	0	0	0	0
LARIX OCCIDENTALIS	0	0	0	0	0	0	0	0	0	0	17
PICEA ENGELMANNII	0	0	0	0	0	0	0	0	0	0	17
SPECIES UNKNOWN	0	0	0	0	0	0	0	0	0	0	0
PERCENT CANOPY COVERAGE FOR INDIVIDUAL TREE SPECIES (OVERSTORY/UNDERSTORY)											
PINUS PONDEROSA ≥4 IN DBH	0	0	.5	0	0	0	40.5	28.2	0	0	0
PINUS PONDEROSA <4 IN DBH	0	0	0	0	0	0	0	.5	0	0	0
PSEUDOTSUGA MENZIESII ≥4 IN DBH	22.2	43.0	49.0	31.0	40.5	23.0	3.5	11.0	52.5	23.0	0
PSEUDOTSUGA MENZIESII <4 IN DBH	3.0	3.0	0	4.0	.5	3.0	15.0	3.0	15.0	.5	.2
PINUS CONTORTA ≥4 IN DBH	.5	.2	0	3.2	0	.5	0	0	3.0	3.0	.5
PINUS CONTORTA <4 IN DBH	0	.5	0	.5	0	0	0	.2	.5	3.0	3.0
LARIX OCCIDENTALIS ≥4 IN DBH	40.5	.2	0	0	0	15.0	3.5	0	0	.2	0
LARIX OCCIDENTALIS <4 IN DBH	0	0	0	0	0	0	0	.5	0	0	.2
ABIES LASIOCARPA ≥4 IN DBH	.5	3.2	3.2	.2	16.0	8.0	0	0	.5	3.0	0
ABIES LASIOCARPA <4 IN DBH	.5	4.0	3.0	.5	8.0	8.0	0	0	8.0	15.0	3.0
PICEA ENGELMANNII ≥4 IN DBH	0	0	0	0	0	3.0	0	0	0	0	0
PICEA ENGELMANNII <4 IN DBH	0	0	0	0	.2	0	0	0	0	0	.5
PINUS ALBICAULIS ≥4 IN DBH	0	3.0	0	0	3.0	0	0	0	0	0	0
PINUS ALBICAULIS <4 IN DBH	0	.5	0	0	0	.5	0	.2	0	3.0	.5
PERCENT CANOPY COVERAGE FOR INDIVIDUAL UNDERGROWTH SPECIES											
105 AMELANCHIE ALNIFOLIA	.5	.5	0	.5	.5	0	.5	.5	0	0	0
107 CEANOTHUS VELUTINUS	0	0	.5	0	0	0	0	37.5	0	0	0
115 LONICERA UTAHENSIS	.5	0	0	.5	.5	0	0	0	0	0	0
118 PACHISTIMA MYRSINITES	.5	0	0	0	0	4.0	0	0	0	0	0
131 RIBES VISCOSISSI	0	0	.5	0	.5	0	0	0	0	0	0
137 SALIX SCOULERIAN	.2	0	0	0	0	0	.5	.5	0	0	.5
142 SPIRAEA BETULIFOLI	.5	.5	0	0	0	0	3.0	2.0	.5	.5	0
146 VACCINIUM GLOBULARE	46.0	54.0	54.0	28.0	.5	37.5	62.5	46.0	8.0	28.0	28.0
148 VACCINIUM SCOPARIUM	0	8.0	0	0	0	0	0	0	3.0	3.0	22.0
201 ARCTOSTAPH UVA-URSI	3.0	0	0	.5	0	3.0	15.0	0	0	.5	0
203 BERBERIS REPENS	.5	0	0	.5	0	0	.5	.5	.5	0	0
307 CALAMAGROS RUBESCENS	15.0	0	3.0	46.0	.5	.5	85.0	62.5	37.5	0	0
308 CAREX CONCINNOID	3.0	.5	0	.5	0	.5	0	.5	3.0	.5	3.0
309 CAREX GEYERI	15.0	.5	3.0	15.0	37.5	.5	.5	.5	3.0	.5	3.0
311 CAREX ROSSII	0	.5	0	0	0	0	0	0	.5	0	3.0
401 ACHILLEA MILLEFOLIU	0	.5	0	0	0	0	0	0	0	0	.5
405 ANAPHALIS MARGARITAC	0	0	0	0	0	0	0	0	0	0	2.0
413 ANTENNARIA RACEMOSA	3.0	.5	0	15.0	0	.5	.5	0	3.0	.5	0
422 ARNICA LATIFOLIA	.5	3.0	.5	0	22.0	8.0	0	0	22.0	22.0	.5
426 ASTER CONSPICUUS	0	0	0	3.0	3.0	0	0	0	.5	0	0
442 CHIMAPHILA UMBELLATA	.5	.5	0	.5	.5	3.0	0	.5	.5	3.0	0
459 EPILOBIUM ANGUSTIFOL	0	0	.5	.5	.5	0	0	.5	0	0	.5
466 FRAGARIA VIRGINIANA	.5	0	0	.5	0	0	.5	0	.5	0	0
476 GOODYERA OBLONGIFOL	.5	.5	.5	.5	0	.5	0	.5	0	.5	0
488 HEDYSARUM OCCIDENTAL	0	0	.5	0	0	0	0	0	0	0	0
484 HIERACIUM ALBIFLORUM	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5	.5
509 PEDICULARI RACEMOSA	.5	.5	.5	0	0	0	0	0	0	.5	0
510 PENSTEMON ALBERTINUS	0	0	0	0	0	0	0	0	0	0	0
529 PYROLA SECUNDA	.5	0	.5	0	0	.5	0	0	.5	.5	0
547 THALICTRUM OCCIDENTAL	0	0	3.0	3.0	15.0	0	0	0	0	0	0
558 XEROPHYLLU TENAX	46.0	62.5	72.0	46.0	37.5	37.5	.5	.5	15.0	46.0	22.0

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		V-V-X C.T.	XETE C.T.			CARU C.T.	LP/VASC-VAGL-XETE C.T.					
HABITAT TYPE CODE		AF/XFTE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE
SITE NUMBER		23	14	14	23	30	2	2	5	8	16	20
STAND NUMBER		3	4	3	2	2	3	4	3	2	2	3
TREATMENT CODE * (SEE FOOTNOTE)		BB	BB	MS	MS	MS	MS	WP	MS	WF	WF	MS
STAND AGE (YEARS)		10	14	14	10	6	24	24	19	41	25	21
YEARS SINCE GROUND FIRE		10	14	14	10	6	24	220	59	41	25	21
ASPECT (IN DEGREES)		182	138	140	190	125	260	286	225	322	264	120
ELEVATION (IN FEET)		7600	7250	7250	7000	6550	6700	6790	6400	6000	6450	6100
SLOPE (IN DEGREES)		14	31	25	12	10	15	12	15	22	24	19
PERCENT TREE CANOPY COVERAGE		0	0	5	1	7	15	25	40	55	35	25
DOMINANT TREE DBH (INCHES)		0	0	1	0	0	2	2	2	2	3	4
BASAL AREA (SQ FT/ACRE)		0	0	1	0	0	2	11	6	35	36	26
CURRENT STOCKING CODE **		0	0	2	1	2	2	2	2	2	2	2
NUMBER OF TIMES PLANTED		0	1	1	1	1	0	0	0	0	0	0
PERCENT BARE MINERAL SOIL		1	1	3	25	15	20	1	2	0	1	2
YEARS SINCE PLANTING												
PINUS PONDEROSA		0	0	0	0	0	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII		0	12	12	0	0	0	0	0	0	0	0
PINUS CONTORTA		0	0	0	9	0	0	0	0	0	0	0
LARIX OCCIDENTALIS		0	0	0	9	0	0	0	0	0	0	0
PICEA ENGELMANNII		0	0	0	9	0	0	0	0	0	0	0
SPECIES UNKNOWN		0	0	0	0	5	0	0	0	0	0	0
PERCENT CANOPY COVERAGE FOR INDIVIDUAL TREE SPECIES (OVERSTORY/UNDERSTORY)												
PINUS PONDEROSA	≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PINUS PONDEROSA	<4 IN DBH	0	0	0	0	.2	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII	≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII	<4 IN DBH	0	0	.5	0	.5	.5	.5	.5	.5	.5	0
PINUS CONTORTA	≥4 IN DBH	0	0	0	0	0	0	0	0	0	.5	.5
PINUS CONTORTA	<4 IN DBH	.5	0	3.0	.5	8.0	15.0	15.0	22.0	54.0	37.5	22.0
LARIX OCCIDENTALIS	≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
LARIX OCCIDENTALIS	<4 IN DBH	0	0	0	.5	0	0	0	0	0	0	0
ABIES LASIOCARPA	≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
ABIES LASIOCARPA	<4 IN DBH	.5	0	.5	0	.5	.5	8.0	2.0	.5	0	0
PICEA ENGELMANNII	≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PICEA ENGELMANNII	<4 IN DBH	.2	0	.5	0	0	0	0	.5	.5	0	0
PINUS ALBICAULIS	≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PINUS ALBICAULIS	<4 IN DBH	.5	0	.5	.5	0	.5	3.0	0	0	0	.2
PERCENT CANOPY COVERAGE FOR INDIVIDUAL UNDERGROWTH SPECIES												
105 AMELANCHIE	ALNIFOLIA	0	0	0	0	0	0	0	0	0	0	.5
107 CEANOTHUS	VELUTINUS	0	0	0	0	0	0	0	0	0	0	0
115 LONICERA	UTAHENSIS	0	0	0	0	0	0	0	0	0	0	0
119 PACHISTIMA	MYRSINITES	0	0	0	0	0	0	0	0	0	0	0
131 RIBES	VISCOSISSI	0	.5	.5	0	0	0	0	0	.5	0	0
137 SALIX	SCOULERIAN	0	0	.5	.5	0	.5	.5	0	.5	.5	.5
142 SPIRAEA	BETULIFOLI	0	.2	0	.5	0	3.0	.5	0	.5	4.0	.5
146 VACCINIUM	GLOBULARE	15.0	3.0	.5	3.0	.5	.5	3.0	37.5	15.0	28.0	22.0
148 VACCINIUM	SCOPARIUM	15.0	3.0	.5	.5	15.0	15.0	28.0	.5	62.5	37.5	8.0
201 ARCTOSTAPH	UVA-URSI	0	0	0	0	0	0	0	0	0	0	0
203 BERBERIS	REPENS	0	.5	0	0	0	0	0	0	0	0	0
307 CALAMAGROS	RUBESCENS	0	37.5	4.0	.5	37.5	.5	0	0	0	4.0	4.0
308 CAREX	CONCINNOID	0	.5	.5	0	8.0	.5	.5	0	.5	.5	.5
309 CAREX	GEYERI	15.0	15.0	8.0	15.0	3.0	8.0	15.0	8.0	.5	4.0	3.0
311 CAREX	ROSSII	1.0	0	.5	15.0	8.0	.5	.5	.5	.5	.5	.5
401 ACHILLEA	MILLEFOLIU	0	0	.5	.5	0	0	0	2.0	.2	.5	.5
405 ANAPHALIS	MARGARITAC	0	0	.5	.5	.5	0	0	4.0	.5	.2	0
413 ANTENNARIA	RACEMOSA	0	0	.5	0	0	.5	0	0	.5	.5	0
422 ARNICA	LATIFOLIA	3.0	.5	2.0	.5	.5	.5	.5	.5	.5	.5	0
426 ASTER	CONSPICUUS	0	8.0	8.0	0	.5	0	0	0	0	0	0
442 CHIMAPHILA	UMBELLATA	0	0	0	0	0	0	0	0	0	0	0
459 EPILOBIUM	ANGUSTIFOL	.5	.5	15.0	.5	.5	.5	.5	.5	.5	.5	.5
466 FRAGARIA	VIRGINIANA	0	.5	.5	0	0	0	0	0	0	0	0
476 GOODYERA	OBLONGIFOL	0	0	0	0	0	0	0	0	0	0	0
480 HEDYSARUM	OCCIDENTAL	.5	0	0	.5	0	22.0	15.0	0	0	46.0	28.0
484 HIERACIUM	ALBIFLORUM	.5	.5	.5	.5	.5	.5	0	.5	.5	.5	0
489 PEDICULARI	RACEMOSA	0	0	0	0	0	.5	0	0	0	0	0
510 PENSTEMON	ALBERTINUS	0	0	0	0	0	.5	0	0	0	0	0
529 PYROLA	SECUNDA	0	0	0	0	0	0	0	0	0	0	0
547 THALICTRUM	OCCIDENTAL	0	.5	0	.5	0	0	0	0	0	0	0
558 XEROPHYLLU	TENAX	46.0	62.5	46.0	15.0	3.0	29.0	46.0	8.0	3.0	46.0	46.0

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	SAPLING STAGE (FIG. 4)			DENSE POLE STAGE							MATURE SERAL FOREST
	LP/CARU C.T.		LP/CARO	LP/VASC-VAGL-XETE C.T.							LP-AF/ V-V-X
HABITAT TYPE CODE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE
T NUMBER	17	21	5	7	18	5	20	2	14	8	7
HD NUMBER	2	2	4	2	2	2	2	2	2	1	1
TREATMENT CODE * (SEE FOOTNOTE)	MS	WF	MS	WF	WF	WF	WF	WF	WF	CO	CO
STAND AGE (YEARS)	9	17	19	41	59	59	80	88	88	118	125
YEARS SINCE GROUND FIRE	9	17	59	41	59	59	80	88	88	118	125
ASPECT (IN DEGREES)	185	187	225	133	188	225	126	262	155	320	124
ELEVATION (IN FEET)	6000	6700	6400	6700	6200	6400	6100	6700	7200	6900	6700
SLOPE (IN DEGREES)	10	11	15	23	11	15	10	15	22	19	21
PERCENT TREE CANOPY COVERAGE	18	38	40	55	60	55	75	70	90	70	50
DOMINANT TREE DBH (INCHES)	2	2	1	5	8	11	8	8	8	8	11
BASAL AREA (SQ FT/ACRE)	9	26	6	59	140	127	236	167	190	216	144
CURRENT STOCKING CODE **	2	2	2	2	2	2	2	2	2	2	2
NUMBER OF TIMES PLANTED	0	0	0	0	0	0	0	0	0	0	0
PERCENT BARE MINERAL SOIL	4	15	15	2	0	1	0	0	0	0	1
YEARS SINCE PLANTING											
PINUS PONDEROSA	0	0	0	0	0	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII	0	0	0	0	0	0	0	0	0	0	0
PINUS CONTORTA	0	0	0	0	0	0	0	0	0	0	0
LARIX OCCIDENTALIS	0	0	0	0	0	0	0	0	0	0	0
PICEA ENGELMANNII	0	0	0	0	0	0	0	0	0	0	0
SPECIES UNKNOWN	0	0	0	0	0	0	0	0	0	0	0
PERCENT CANOPY COVERAGE FOR INDIVIDUAL TREE SPECIES (OVERSTORY/UNDERSTORY)											
PINUS PONDEROSA ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PINUS PONDEROSA <4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	3.0
PSEUDOTSUGA MENZIESII <4 IN DBH	.5	.5	.5	.5	.5	.5	.5	.5	.5	.2	3.0
PINUS CONTORTA ≥4 IN DBH	0	0	0	15.0	54.0	40.5	62.5	62.5	62.5	62.5	25.0
PINUS CONTORTA <4 IN DBH	15.0	37.5	22.0	22.0	3.0	3.0	3.0	3.0	3.0	3.0	.5
LARIX OCCIDENTALIS ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
LARIX OCCIDENTALIS <4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
ABIES LASIOCARPA ≥4 IN DBH	0	0	0	0	0	.5	0	0	3.0	0	15.0
ABIES LASIOCARPA <4 IN DBH	0	.5	2.0	3.0	0	.5	0	0	.5	.5	4.0
PICEA ENGELMANNII ≥4 IN DBH	0	0	0	0	0	.2	0	0	0	0	0
PICEA ENGELMANNII <4 IN DBH	0	0	3.0	0	0	0	0	0	0	0	0
[illegible]US ALBICAULIS ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0	0
[illegible]US ALBICAULIS <4 IN DBH	0	.5	0	0	.5	.5	0	0	0	0	0

PERCENT CANOPY COVERAGE FOR INDIVIDUAL UNDERGROWTH SPECIES

105	AMELANCHIE	ALNIFOLIA	0	0	0	0	0	0	.5	0	0	0	0
107	CEANOTHUS	VELUTINUS	0	0	0	0	0	0	0	0	0	0	0
115	LONICERA	UTAHENSIS	.5	0	0	0	0	0	0	0	0	0	0
118	PACHISTIMA	MYRSINITES	0	0	0	0	0	0	0	0	0	0	0
131	RIBES	VISCOSISSI	0	0	0	.5	0	0	0	0	0	0	0
137	SALIX	SCOULERIAN	.5	1.0	0	0	0	0	0	0	.5	0	0
142	SPIRAEA	BETULIFOLI	4.0	.5	0	.5	.5	0	0	3.0	0	.5	.5
146	VACCINIUM	ALDRIJLARE	0	2.0	.5	17.5	37.5	62.5	62.5	8.0	85.0	3.0	46.0
148	VACCINIUM	SCOPARIUM	3.0	3.0	.5	3.0	54.0	22.0	37.5	62.5	28.0	82.5	8.0
201	ARCTOSTAPH	UVA-URSI	.5	.5	0	0	0	0	0	0	0	0	0
203	BERBERIS	REPENS	.5	0	0	0	0	0	0	0	.5	0	0
307	CALAMAGROS	RUBESCENS	37.5	37.5	0	.5	.5	0	.5	0	.5	0	.5
308	CAREX	CONCINNOID	3.0	.5	0	.5	0	0	.5	0	.5	.5	.5
309	CAREX	GEYERI	0	.5	.5	3.0	.5	.5	0	.5	0	.5	8.0
311	CAREX	ROSSII	.5	.5	8.0	.5	0	.5	0	0	0	.5	0
401	ACHILLEA	MILLEFOLIU	0	0	3.0	0	0	0	0	0	0	0	0
405	ANAPHALIS	MARGARITAC	0	.5	8.0	0	0	0	0	0	0	0	0
413	ANTENNARIA	RACEMOSA	0	.5	.5	.5	0	0	0	0	0	.2	0
422	ARNICA	LATIFOLIA	.5	0	.5	0	0	.5	0	.5	0	.5	8.0
426	ASTER	CONSPICUUS	0	0	0	0	0	0	0	0	.5	0	0
442	CHIMAPHILA	UMBELLATA	0	0	0	0	0	0	.5	.5	.5	.5	2.0
459	EPILOBIUM	ANGUSTIFOL	.5	.5	0	.5	.5	0	0	0	.5	0	0
466	FRAGARIA	VIRGINIANA	0	0	0	0	0	0	0	0	0	0	0
476	GOODYERA	OBLONGIFOL	0	0	0	0	0	0	0	0	0	0	0
480	HEDYSARUM	OCCIDENTAL	.5	0	0	.5	.5	0	.5	15.0	0	0	0
484	HIERACIUM	ALBIFLORUM	.5	.5	.5	.5	.5	.5	0	0	0	.5	.5
509	PEDICULARI	RACEMOSA	0	.5	0	0	0	0	0	0	0	0	0
518	PENSTEMON	ALBERTINUS	0	0	0	0	0	0	0	0	0	0	0
529	PYROLA	SECUNDA	0	0	0	0	0	0	0	0	0	0	0
547	THALICTRUM	OCCIDENTAL	0	0	0	0	0	0	0	0	0	0	0
558	XEROPHYLLU	TENAX	2.0	.5	.5	42.5	45.0	62.5	37.5	37.5	46.0	3.0	72.0

* KEY TO TREATMENT CODES

CO = CONTROL (OLD GROWTH STAND)
WP = CLEARCUT WITH NO SITE PREPARATION
BB = CLEARCUT FOLLOWED BY BROADCAST BURNING
MS = CLEARCUT FOLLOWED BY MECHANICAL SCARIFICATION
[illegible]

** KEY TO CURRENT STOCKING CODE

0 = INADEQUATE STOCKING
1 = NEARLY ADEQUATE STOCKING
2 = ADEQUATE STOCKING

	LP-AF/VASC-VAGL-XETE C.T.						AF-LP/VASC-VAGL-XETE C.T.			
HABITAT TYPE CODE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE	AF/XETE
SITE NUMBER	18	23	30	21	16	17	15	2	5	14
STAND NUMBER	1	1	1	1	1	1	1	1	1	1
TREATMENT CODE * (SEE FOOTNOTE)	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO
STAND AGE (YEARS)	137	160	170	140	190	190	210	220	300	250
YEARS SINCE GROUND FIRE	59	160	74	140	190	130	210	220	300	90
ASPECT (IN DEGREES)	200	190	110	185	262	180	130	275	215	140
ELEVATION (IN FEET)	6700	7000	6950	6700	6400	6000	6200	6700	6400	7200
SLOPE (IN DEGREES)	11	14	10	9	24	8	9	14	11	21
PERCENT TREE CANOPY COVERAGE	45	60	60	75	60	65	80	60	45	40
DOMINANT TREE DBH (INCHES)	14	15	10	10	10	10	14	14	13	12
BASAL AREA (SQ FT/ACRE)	170	299	153	40	120	137	151	103	101	68
CURRENT STOCKING CODE **	2	2	2	2	2	2	2	2	2	2
NUMBER OF TIMES PLANTED	0	0	0	0	0	0	0	0	0	0
PERCENT BARE MINERAL SOIL	0	0	0	1	0	0	0	0	0	0
YEARS SINCE PLANTING										
PINUS PONDEROSA	0	0	0	0	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII	0	0	0	0	0	0	0	0	0	0
PINUS CONTORTA	0	0	0	0	0	0	0	0	0	0
LARIX OCCIDENTALIS	0	0	0	0	0	0	0	0	0	0
PICEA ENGELMANNII	0	0	0	0	0	0	0	0	0	0
SPECIES UNKNOWN	0	0	0	0	0	0	0	0	0	0
PERCENT CANOPY COVERAGE FOR INDIVIDUAL TREE SPECIES (OVERSTORY/UNDERSTORY)										
PINUS PONDEROSA ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0
PINUS PONDEROSA <4 IN DBH	0	0	0	0	0	0	0	0	0	0
PSEUDOTSUGA MENZIESII ≥4 IN DBH	1.0	0	.2	6.0	3.2	0	0	0.2	3.0	.4
PSEUDOTSUGA MENZIESII <4 IN DBH	.2	0	.5	3.0	15.0	.5	0	0	0	.5
PINUS CONTORTA ≥4 IN DBH	30.0	30.0	62.5	8.0	15.0	54.0	3.0	6.0	6.0	3.5
PINUS CONTORTA <4 IN DBH	.5	.5	.5	.5	.5	.5	0	0.0	0	3.0
LARIX OCCIDENTALIS ≥4 IN DBH	0	0	0	0	0	0	0	0	0	0
LARIX OCCIDENTALIS <4 IN DBH	0	0	0	0	0	0	0	0	0	0
ABIES LASIOCARPA ≥4 IN DBH	.2	30.0	0	3.0	7.0	0	15.2	11.0	15.2	18.0
ABIES LASIOCARPA <4 IN DBH	.5	4.0	.5	3.0	3.0	.5	46.0	15.0	15.0	3.0
PICEA ENGELMANNII ≥4 IN DBH	0	.2	0	0	0	0	3.0	0	3.2	0
PICEA ENGELMANNII <4 IN DBH	0	.2	0	0	0	0	.5	0	3.0	0
PINUS ALBICAULIS ≥4 IN DBH	.2	7.0	0	0	0	0	6.0	.2	2.0	0
PINUS ALBICAULIS <4 IN DBH	.2	.5	0	.5	.5	.5	0	.5	0	3.0
PERCENT CANOPY COVERAGE FOR INDIVIDUAL UNDERGROWTH SPECIES										
105 AMELANCHIE ALNIFOLIA	0	0	0	0	0	0	0	0	0	0
107 CEANOTHUS VELUTINUS	0	0	0	0	0	0	0	0	0	0
115 LONICERA UTAHENSIS	0	0	0	0	0	0	0	0	0	0
118 PACHISTIMA MYRSINITES	0	0	0	0	0	0	0	0	0	0
131 RIBES VISCOSISSI	0	0	0	0	0	0	0	0	0	0
137 SALIX SCOULERIAN	.5	0	0	.5	.5	0	0	0	0	0
142 SPIRAEA BETULIFOLI	.5	0	0	.5	.5	.5	0	.5	0	0
146 VACCINIUM GLOBULARE	44.0	72.0	1.0	8.0	72.0	18.0	46.0	4.0	72.0	62.5
148 VACCINIUM SCOPARIUM	72.0	2.0	72.0	72.0	54.0	62.5	46.0	54.0	15.0	37.5
201 ARCTOSTAPH UVA-URSI	0	0	0	0	0	.5	0	0	0	0
203 BERBERIS REPENS	0	0	.5	0	0	0	0	0	0	.2
307 CALAMAGROS RUBESCENS	1.0	.5	3.0	4.0	0	3.0	0	0	0	.2
308 CAREX CONCINNOID	.5	0	.5	.5	.5	0	0	.5	0	.5
309 CAREX GEYERI	1.0	.5	.5	2.0	.5	0	.5	.5	.5	.5
311 CAREX ROSSII	0	0	0	.5	0	0	.5	0	0	0
401 ACHILLEA MILLEFOLIU	0	0	0	0	0	0	0	0	0	0
405 ANAPHALIS MARGARITAC	0	0	0	0	0	0	0	0	0	0
413 ANTENNARIA RACEMOSA	0	0	.5	0	0	0	0	0	0	0
422 ARNICA LATIFOLIA	.5	15.0	3.0	.5	.5	2.0	.5	.5	.5	.2
426 ASTER CONSPICUUS	0	0	0	0	0	0	0	0	0	0
442 CHIMAPHILA UMBELLATA	0	.5	8.0	.5	.5	.5	.5	.5	.5	.5
459 EPILOBIUM ANGUSTIFOL	0	0	0	0	0	0	0	0	0	0
466 FRAGARIA VIRGINIANA	0	0	0	0	0	0	0	0	0	0
476 GOODYERA OBLONGIFOL	0	.5	.5	.5	0	.5	.5	0	.5	0
480 HEDYSARUM OCCIDENTAL	.5	.5	0	0	22.0	.5	0	4.0	0	0
484 HIERACIUM ALBIFLORUM	.5	0	.5	.5	.2	.5	0	.5	.5	0
489 PEDICULARI RACEMOSA	0	0	.5	8.0	0	.5	0	.5	0	0
510 PENSTEMON ALBERTINUS	0	0	0	0	0	0	0	0	0	0
529 PYROLA SECUNDA	0	0	0	0	0	0	.5	.5	.5	.5
547 THALICTRUM OCCIDENTAL	0	0	0	0	0	0	0	0	0	.5
558 XEROPHYLLU TENAX	37.5	46.0	37.5	8.0	46.0	3.0	22.0	37.5	85.0	85.0

* KEY TO TREATMENT CODES

CO = CONTROL (OLD GROWTH STAND)
WP = CLEARCUT WITH NO SITE PREPARATION
BR = CLEARCUT FOLLOWED BY BROADCAST BURNING
MS = CLEARCUT FOLLOWED BY MECHANICAL SCARIFICATION
WF = WILDFIRE

** KEY TO CURRENT STOCKING CODE

0 = INADEQUATE STOCKING
1 = NEARLY ADEQUATE STOCKING
2 = ADEQUATE STOCKING

Table 2. - Estimated number of years required to obtain tree regeneration (@ 300, one foot tall seedlings/acre) in Pseudotsuga/Vaccinium globulare and Abies lasiocarpa habitat type sample stands. Seedling species listed in capital letters are generally well stocked; lower case indicates lightly stocked components. (n=number of stands)

TYPE of TREATMENT	Habitat Type							
	PSME/VAGL & ABLA/XETE WARM PHASE				ABLA/XETE COLD PHASE			
	n	No. of Years Median	Range	Principal Seedlings	n	No. of Years Median	Range	Principal Seedlings
CCNP	7	>23	18-25	df, af, lp	1	*		
CCBB	13	>15	6-22	df, lp	3	>15	10-20	lp
CCMS	11	12	3-24	LP, DF	11	7	3-15	LP, af, df
WF	9	12	6-17	LP, DF, wl	10	13	8-18	LP

* Only one stand in this category. It restocked in 8 years to LP, AF, wbp.

Table 3. - Apparent planting success (S/A = successes/attempts) by species and treatment type in all the Pseudotsuga/Vaccinium globulare and Abies lasiocarpa/Xerophyllum habitat type sample stands that had planting records. Success is defined here as establishing that species as a major component of the new stand as a result of planting.

TYPE of TREATMENT	TREE SPECIES PLANTED				
	DF	LP	PP	WL	ES
	S/A	S/A	S/A	S/A	S/A
CCBB	0/9	0/3	0/5		
CCMS	2/8	1/4	0/3	0/2	0/1

Table 4.--Response of undergrowth species to four different treatments in the Pseudotsuga/Vaccinium globulare and Abies lasiocarpa/Xerophyllum habitat types in west-central Montana. Letter codes were applied as follows based up samples from pair (untreated vs. treated) stands. Capitol letters signify major undergrowth components (coverage ≥5% in ≥50% of either untreated or treated stands). Lower case lettering is used for minor components. (A detailed listing of coverage data for all individual stand pairs is in Appendix A.)

i or I = generally increases in coverage
i or I = strongly increases
d or D = generally decreases
d or D = strongly decreases
lc or LC = little or inconsistent change in coverage
* = insufficient data to judge this species in this category.

Treatment codes
CC = clearcut
NP = no site preparation
MS = mechanically scarified
BB = broadcase burned

	Treatment type and age-since-treatment category							
	CCNP	CCMS ⟷		CCBB		Wildfire ⟷		
	13-24 years	6-10 years	13-24 years	6-11 years	13-23 years	17-30 years	41-68 years	74-105 years
No. of pairs of stands	8	5	17	6	10	5	9	10
Plants								
Amelanchier alnifolia	i	*	lc	lc	i	lc	lc	lc
Ceanothus velutinus	lc	i	i	i	i	lc	lc	d
Salix scouleriana	i	I	I	i	I	i	i	I
Spiraea betulifolia	lc	i	i	i	i	i	lc	lc
Vaccinium globulare	D	D	D	D	D	D	LC	LC
V. scoparium (in cold phase of H.T.)	D	D	D	lc	D	D	LC	LC
Calamagrostis rubescens	I	I	I	LC	I	LC	d	lc
Carex geyeri	I	I	I	I	I	lc	d	d
Carex rossii	lc	I	i	I	i	i	i	d
Achillea millefolium	i	i	i	i	i	i	lc	lc
Anaphalis margaritaceae	i	i	i	lc	i	i	lc	lc
Arnica latifolia	d	d	d	D	d	lc	lc	lc
Aster conspicuus	lc	*	i	i	lc	*	lc	lc
Chimaphila umbellata	d	d	d	d	d	d	d	lc
Epilobium angustifolium	I	i	i	i	i	I	i	lc
Goodyera oblongifolia	d	d	d	d	d	d	lc	lc
Xerophyllum tenax	LC	D	D	LC	D	D	LC	LC

Table 5.--Response of undergrowth species to four different treatments in the Pseudotsuga/Physocarpus habitat type in west-central Montana. Letter codes were applied as follows based upon samples from paired (untreated vs. treated) stands. Capitol letters signify major undergrowth components (coverage ≥5% in ≥50% of either untreated or treated stands). Lower case lettering is used for minor components.

i or I = generally increases in coverage
i or I = strongly increases
d or D = generally decreases
d or D = strongly decreases
lc of LC = little or inconsistent change in coverage
* = insufficient data to judge this species in this category.

Treatment Codes
CC = clearcut
NP = no site preparation
MS = mechanically scarified
BB = broadcast burned

(A detailed listing of coverage data for all individual stand pairs is in Appendix B.)

	Treatment type and age-since-treatment category							
	CCNP ←	→	CCMS	CCBB	Wildfire →			
	4-15 years	20-28 years	14-28 years	4-23 years	5 years	32-48 years	58-67 years	78-90 years
No. of pairs of stands	8	4	7	5	3	5	11	3
Plants								
Acer glabrum	lc	lc	lc	i	lc	lc	i	i
Amelanchier alnifolia	i	I	lc	i	LC	I	I	I
Ceanothus velutinus	lc	i	i	i	i	I	i	i
Physocarpus malvaceous	LC	LC	LC	LC	LC	LC	LC	LC
Salix scouleriana	i	i	i	i	*	i	i	*
Spiraea betulifolia	i	i	lc	lc	I	i	lc	lc
Symphoricarpos albus	I	i	lc	I	I	lc	lc	lc
Vaccinium globulare	d	*	d	d	*	*	*	*
Berberis repens	lc	lc	lc	lc	lc	lc	lc	i?
Calamagrostis rubescens	I	D	D	LC	LC	D	D	D
Carex geyeri	LC	LC	I	LC	D	I	LC	LC
Arnica cordifolia	d	d	d	*	*	d	d	d
Goodyera oblongifolia	d	lc	d	d	*	d	lc	lc

Appendix C. Key for identifying successional stages and undergrowth community types within the Pseudotsuga/Vaccinium globulare and Abies lasiocarpa/Xerophyllum habitat types in west-central Montana.

A_1. Forest stands have Vaccinium scoparium "well represented" (>5% canopy coverage), and Pseudotsuga is not "abundant" (>25% canopy coverage). Larix and Calamagrostis rubescens are "poorly represented" (<5% canopy coverage). Sites are generally at higher elevations within the ABLA/XETE habitat types, i.e., in the COLD PHASE . . . succession diagrammed in Figure 4.

A_2. Forest stands not as above. Sites in the PSME/VAGL habitat type or at lower to middle elevations within the ABLA/XETE habitat type, i.e., in the WARM PHASE . . . Succession diagrammed in Figure 3.

B. Choose the structural stage from the top of Figure 3 or 4 that best fits the stand by selecting the most applicable data on total canopy coverage of trees, dbh of average dominant trees, and total stand age.

C. For "shrub and herb" or "sapling" stage stands, choose the undergrowth union or community type (c.t.) by assigning the undergrowth name associated with the first of the following statements that applies:

WARM PHASE KEY
(cf. Figure 3)

1. Ribes viscosissimum or Salix scouleriana well represented--

RIVI-SASC c.t.
(Relatively moist sites bordering ABLA/MEFE or ABLA/LIBO habitat types; Larix usually well represented in natural stands.)

2. Amelanchier alnifolia or Ceanothus velutinus well represented--

AMAL-CEVE c.t.
(Relatively warm and dry sites often having some Pinus ponderosa in natural stands.)

3. Vaccinium globulare well represented-- VAGL-XETE c.t.

(Initial c.t. on most Larix-supporting sites, or represents a progression on drier sites from CARU or XETE c.t.s)

4. Xerophyllum tenax well represented-- XETE c.t.

(Initial c.t. on many non-Larix sites where (1) VAGL is poorly represented in natural stands (too dry?), (2) severe site drought-exposure after treatment decreased VAGL, or (3) severe burning decreased VAGL.)

5. Heavily overstocked Pinus contorta seedlings dominate the undergrowth-- PICO seedlings/ or PICO saplings/ depauperate undergrowth c.t.

(Results after hot wildfire in Pinus contorta stands with quantities of serotinous cones.)

6. Calamagrostis rubescens or Carex geyeri well represented--

CARU c.t.

(Initial c.t. on many warm, dry non-Larix sites after scarification or hot burns, especially where either VAGL or XETE are scarce in forest stands.)

7. Carex rossii or Anaphalis margaritaceae well represented--

CARO c.t.

(Results from heavy, deep scarification, or exceptionally hot slash fires especially when CARU and CAGE are scarce in forest stands.)

COLD PHASE KEY
(cf. Figure 4)

1. Vaccinium scoparium or V. globulare well represented

VASC-VAGL-XETE c.t.

(Initial c.t. on relatively moist sites without severe site treatment, or represents a progression on drier sites from CARU or XETE c.t.s).

2. Xerophyllum tenax well represented — XETE c.t.

   (Initial c.t. on relatively dry sites (steep south exposures) or after severe burning treatment.)

3. Heavily overstocked Pinus contorta seedlings dominate the undergrowth

   (Results after hot wildfire in Pinus contorta stands with large quantities of serotinous cones.)

   PICO seedlings or PICO saplings/ depauperate undergrowth

4. Calamagrostis rubescens or Carex geyeri well represented

   (Initial c.t. on some dry sites especially after scarification or hot burns.) — CARU c.t.

5. Carex rossii or Anaphalis margaritaceae well represented

   (Results from heavy, deep scarification, or exceptionally hot slash fires especially when CARU and CAGE are scarce in forest stands.) — CARO c.t.

Appendix A. Percent canopy coverage for principal undergrowth species in all paired (untreated vs. treated) sample stands in the *Pseudotsuga/Vaccinium globulare* and *Abies lasiocarpa/Xerophyllum* habitat types in west-central Montana. Stand pairs are grouped into 8 treatment type and age-since-treatment categories (same as Table 1). U = untreated, T = treated; species names are spelled out in Table 1.

Site No.	Plot Letter	AMAL		CEVE		SASC		SPBE		VAGL		VASC		CARU		CAGE		CARO	
	U T	U	T	U	T	U	T	U	T	U	T	U	T	U	T	U	T	U	T
	-- Clearcut with no site preparation 13-24 years ago (8 pairs)																		
x 2	a-d	0	0	0	0	0	.5	.5	.5	4.	3.	54.	28.	0	0	.5	15.	0	.5
x 10	a-d	0	0	.5	0	0	0	0	0	54.	.5	0	0	3.	37.5	3.	15.	0	0
x 27	a-b	.5	3.	0	0	0	0	0	0	.5	0	0	0	.5	.5	37.5	62.5	0	0
x 4	a-b	.5	.5	0	0	0	0	.5	.5	54.	46.	8.	.5	0	3.	.5	8.	.5	.5
x 9	a-c	.5	4.	0	0	0	.5	.5	2.	72.	28.	0	0	8.	22.	22.	22.	0	0
x 13	a-c	0	0	0	0	0	.5	0	0	37.5	4.	0	0	54.	85.	.5	.5	0	0
v 5	a-b	4.	37.5	0	0	0	.5	3.	.5	62.5	.5	0	.5	62.5	37.5	.5	15.	.5	0
v 6	a-c	.5	2.	37.5	4.	.5	.5	2.	15.	46.	2.	0	0	62.5	54.	.5	37.5	0	0
	-- Clearcut with mechanical scarification (± burning) 6-10 years ago (5 pairs)																		
x 30	a-b	0	0	0	0	0	0	0	0	1.	.5	72.	15.	3.	37.5	.5	3.	0	8.
x 17	a-b	0	0	0	0	0	.5	.5	4.	18.	0	62.5	3.	3.	37.5	0	0	0	.5
x 23	a-b	0	0	0	0	0	.5	0	.5	72.	3.	2.	.5	.5	.5	.5	15.	0	15.
x 25	a-b	0	0	.5	22.	.5	.5	3.	15.	37.5	8.	0	0	3.	46.	.5	8.	0	0
v 8	a-b	0	0	0	0	0	1.	.5	.5	62.5	8.	.5	.5	3.	3.	.5	.5	.5	2.
	-- Clearcut with mechanical scarification (± burning) 13-24 years ago (17 pairs)																		
v 4	a-d	0	0	0	0	0	0	.5	.5	.5	0	0	0	3.	46.	3.	3.	0	0
x 19	a-c	0	0	0	0	.2	3.	.5	.5	54.	22.	0	0	22.	62.5	8.	8.	0	0
x 12	a-b	.5	0	0	0	0	2.	0	2.	28.	.5	0	0	46.	62.5	15.	37.5	0	0
x 10	a-e	0	0	.5	8.	0	3.	0	.5	54.	3.	0	0	3.	3.	3.	.5	0	.5
x 11	a-c	0	0	0	0	0	1.	0	0	3.	15.	0	0	3.	.5	.5	3.	0	3.
x 6	a-c	3.	.5	0	0	.2	3.	8.	22.	85.	22.	0	0	15.	72.	.5	.5	0	0
x 22	a-b	.5	0	0	0	.5	.5	.5	15.	37.5	8.	62.5	3.	37.5	15.	3.	0	0	.5
x 3	a-b	.5	15.	0	22.	.2	2.	.5	37.5	46.	8.	0	0	15.	15.	15.	37.5	0	0
x 13	a-d	0	0	0	0	0	.5	.5	0	37.5	15.	0	.5	54.	85.	.5	.5	0	0
x 14	a-c	0	0	0	0	0	.5	0	0	62.5	.5	37.5	.5	.2	4.	.5	8.	0	.5
x 24	a-c	.5	0	0	0	0	.5	.5	1.	37.5	37.5	0	0	0	0	0	0	0	15.
x 15	a-b	0	0	0	0	0	.5	0	0	46.	28.	46.	22.	0	0	.5	3.	.5	3.
x 5	a-c	0	0	0	0	0	0	0	0	72.	37.5	15.	.5	0	0	.5	8.	0	.5
x 5	a-d	0	0	0	0	0	0	0	0	72.	.5	15.	.5	0	0	.5	.5	0	8.
x 20	b-c	.5	.5	0	0	0	.5	0	.5	62.5	22.	37.5	8.	.5	4.	0	3.	0	.5
x 1	a-c	0	0	0	.5	0	.5	.5	3.	28.	8.	3.	22.	0	15.	.5	0	0	0
x 2	a-c	0	0	0	0	0	.5	.5	3.	4.	.5	54.	15.	0	.5	.5	8.	0	.5
	-- Clearcut with broadcast burning 6-11 years ago (6 pairs)																		
x 23	a-c	0	0	0	0	0	0	0	0	72.	15.	2.	15.	.5	0	.5	15.	0	3.
x 29	a-c	0	0	0	0	0	0	.5	0	8.	3.	3.	.5	37.5	46.	3.	15.	.5	.5
v 7	a-b	.5	.5	0	0	0	0	0	.5	.5	0	0	0	22.	62.5	.5	2.	0	.5
x 28	a-c	0	.5	0	2.	0	.5	0	8.	37.5	3.	0	.5	.5	3.	.5	8.	0	.5
v 5	a-c	4.	3.	0	.5	0	.5	3.	3.	62.5	.5	0	.5	62.5	46.	.5	.5	.5	.5
x 26	a-c	.5	0	0	.5	0	0	.5	3.	37.5	22.	0	0	.5	.5	.5	2.	.5	2.
	-- Clearcut with broadcast burning 13-23 years ago (10 pairs)																		
v 4	a-c	0	0	0	0	0	.5	.5	.5	.5	0	0	0	3.	72.	3.	15.	0	.5
x 10	a-c	0	0	.5	.2	0	.5	0	.5	54.	3.	0	0	3.	22.	3.	.5	0	.5
x 19	a-d	0	.2	0	.2	.2	0	.5	2.	54.	22.	0	0	22.	62.5	8.	37.5	0	0
x 27	a-c	.5	3.	0	.5	0	0	0	0	.5	0	0	0	.5	0	37.5	37.5	0	0
x 9	a-d	.5	2.	0	4.	0	0	.5	.5	72.	.2	0	0	8.	8.	22.	46.	0	0
x 11	a-d	0	0	0	.5	0	.5	0	0	3.	37.5	0	0	3.	3.	.5	.5	0	.5
v 1	a-b	3.	22.	.5	37.5	.5	.5	3.	8.	15.	3.	0	0	15.	15.	.5	.5	.5	.5
v 2	a-c	.5	.5	0	15.	0	.2	.5	3.	37.5	28.	0	0	37.5	15.	.5	3.	0	.5
x 14	a-d	0	0	0	0	0	0	0	.2	62.5	3.	37.5	3.	.2	37.5	.5	15.	0	0
x 24	a-d	.5	0	0	0	0	.5	.5	.5	37.5	3.	0	0	0	0	0	0	0	4.
	-- Wildfire (stand-replacing) 17-30 years ago (5 pairs)																		
x 22	a-c	.5	0	0	0	.5	.5	.5	4.	37.5	.5	62.5	4.	37.5	8.	3.	0	0	.5
x 21	a-b	0	0	0	0	.5	1.	.5	.5	8.	2.	22.	3.	4.	37.5	2.	.5	.5	.5
x 16	a-b	0	0	0	0	.6	.5	.5	4.	72.	28.	54.	37.5	0	4.	.5	4.	0	.5
x 24	a-b	.5	.5	0	.5	0	8.	.5	3.	37.5	37.5	0	0	0	.5	0	.5	0	2.
x 19	a-b	0	0	0	0	.2	.5	.5	.5	54.	54.	0	0	22.	28.	8.	.5	0	0
	-- Wildfire (stand-replacing) 41-68 years ago (9 pairs)																		
x 7	a-b	0	0	0	0	0	0	.5	.5	46.	37.5	8.	.3	.5	.5	8.	3.	0	.5
x 8	a-b	0	0	0	0	0	.5	.5	.5	3.	15.	62.5	62.6	0	0	.5	.5	.5	.5
x 18	a-b	0	0	0	0	.5	0	.5	.5	46.	37.5	72.	54.	3.	.5	3.	.5	0	0
x 5	a-b	0	0	0	0	0	0	0	0	72.	62.5	15.	22.	0	0	.5	.5	0	.5
x 28	a-b	0	0	0	0	0	22.	0	3.	37.5	3.	0	0	.5	.5	.5	.5	0	0
v 3	a-b	.5	.5	0	0	.5	3.	3.	15.	62.5	37.5	0	0	85.	62.5	.5	.5	0	0
y 2	a-b	.5	.5	0	.5	0	3.	.5	.5	37.5	37.5	0	0	37.5	22.	.5	0	0	0
x 6	a-b	3.	.5	0	0	.2	2.	8.	3.	85.	46.	0	0	15.	3.	.5	0	0	0
x 10	a-b	0	0	.5	0	0	.5	0	.5	54.	46.	0	3.	3.	.5	3.	.5	0	0
	-- Wildfire (stand-replacing) 74-105 years ago (10 pairs)																		
x 29	a-b	0	0	0	0	0	0	.5	.5	8.	15.	3.	15.	37.5	8.	3.	.5	.5	0
v 4	a-b	0	0	0	0	0	.5	.5	.5	.5	.5	0	.5	3.	3.	3.	.5	0	0
x 9	a-b	.5	.5	0	0	0	.5	.5	72.	46.	0	0	8.	3.	22.	15.	0	0	0
x 13	a-b	0	0	0	0	0	.5	.5	0	37.5	8.	0	.5	54.	54.	.5	.5	0	0
x 2	a-b	0	0	0	0	0	.5	.5	3.	4.	8.	54.	62.5	0	0	.5	.5	0	0
x 1	a-b	0	0	0	0	0	.5	.5	3.	28.	62.5	3.	4.	0	.5	.5	0	0	0
x 14	a-b	0	0	0	0	0	.5	0	0	62.5	85.	37.5	28.	.2	.5	.5	0	0	0
x 11	a-b	0	0	0	0	0	.5	0	0	3.	4.	0	0	3.	2.	.5	.5	0	0
v 6	a-b	.5	.5	37.5	0	.5	2.	2.	4.	46.	22	0	0	62.5	15.	.5	.5	0	0
x 26	a-b	.5	0	0	0	0	.5	.5	.5	37.5	72.	0	0	.5	.5	.5	.5	.5	0

Site No.	Plot Letter	ACMI		ANMA		ARLA		ASCO		CHUM		EPAN		GOOB		XETE	
	U T	U	T	U	T	U	T	U	T	U	T	U	T	U	T	U	T
	-- Clearcut with no site preparation 13-24 years ago (8 pairs)																
x 2	a-d	0	0	0	0	.5	.5	0	0	.5	0	0	.5	0	0	37.5	46.
x 10	a-d	0	.5	0	.5	.5	0	0	0	0	0	.5	.5	.5	0	72.	54.
x 27	a-b	0	0	0	0	22.	.5	3.	0	.5	0	.5	22.	0	0	37.5	37.5
x 4	a-b	.5	.5	0	0	3.	.5	0	0	.5	0	0	0	.5	0	62.5	62.5
x 9	a-c	.5	.5	0	0	0	0	0	.5	.5	0	.5	2.	.5	0	72.	46.
x 13	a-c	0	.5	0	.5	22.	.5	.5	.5	0	0	0	.5	.5	0	37.5	4.
v 5	a-b	0	0	0	0	0	0	0	0	.5	0	0	0	0	0	8.	8.
v 6	a-c	0	.5	0	0	0	0	0	0	.5	0	.5	.5	.5	0	.5	.5
	-- Clearcut with mechanical scarification (± burning) 6-10 years ago (5 pairs)																
x 30	a-b	0	0	0	.5	3.	.5	0	.5	8.	0	0	.5	.5	0	37.5	3.
x 17	a-b	0	0	0	0	2.	.5	0	0	.5	0	0	.5	.5	0	3.	2.
x 23	a-b	0	.5	0	.5	15.	.5	0	0	.5	0	0	.5	.5	0	46.	15.
x 25	a-b	0	0	0	0	0	0	0	0	.5	0	0	.5	.5	0	3.	3.
v 8	a-b	0	.5	0	.5	3.	.5	0	0	8.	.5	0	.5	.5	.5	46.	2.
	-- Clearcut with mechanical scarification (± burning) 13-24 years ago (17 pairs)																
v 4	a-d	0	.5	0	0	3.	0	15.	37.5	0	0	.5	1.	.5	0	37.5	.5
x 19	a-c	.5	.5	0	0	.5	.5	0	0	0	0	0	.5	0	0	62.5	4.
x 12	a-c	0	.5	0	0	0	0	3.	2.	.5	0	.5	.5	.5	0	46.	.5
x 10	a-e	0	.5	0	.5	.5	.5	0	0	0	0	.5	.5	.5	0	72.	2.
x 11	a-c	0	.5	0	.5	37.5	15.	0	0	.5	0	0	.5	.5	0	3.	.5
x 6	a-c	0	.5	0	.5	46.	15.	.5	15.	3.	0	.5	.5	.5	0	3.	3.
x 22	a-b	0	.5	0	.5	0	0	0	.5	.5	0	0	.5	.5	0	3.	.5
x 3	a-b	0	.5	0	0	.5	0	0	8.	.5	0	0	0	.5	.5	46.	8.
x 13	a-d	0	.5	0	.5	22.	.5	.5	28.	0	0	0	.5	.5	0	37.5	0
x 14	a-c	0	.5	0	.5	.2	2.	0	8.	.5	0	0	15.	0	0	85.	46.
x 24	a-c	0	.5	0	15.	.5	.5	0	0	.5	0	0	3.	.5	0	72.	15.
x 15	a-b	0	.5	0	2.	.5	.5	0	0	.5	0	0	.5	.5	0	22.	22.
x 5	a-c	0	2.	0	4.	.5	.5	0	0	.5	0	0	.5	.5	0	85.	8.
x 5	a-d	0	3.	0	8.	.5	.5	0	0	.5	0	0	0	.5	0	85.	5.
x 20	b-c	0	.5	0	0	0	0	0	0	.5	0	0	.5	0	0	37.5	46.
x 1	a-c	0	0	0	0	22.	3.	0	0	3.	0	0	.5	.5	0	46.	28.
x 2	a-c	0	0	0	0	.5	.5	0	0	.5	0	0	.5	0	0	37.5	28.
	-- Clearcut with broadcast burning 6-11 years ago (6 pairs)																
x 23	a-c	0	0	0	0	15.	3.	0	0	.5	0	0	.5	.5	0	46.	46.
x 29	a-c	0	.5	0	0	22.	.5	.5	3.	.5	0	0	.5	0	0	15.	15.
v 7	a-b	0	1.	0	0	.5	0	.5	.5	3.	0	0	.5	.5	0	46.	2.
x 28	a-c	0	.5	0	.5	8.	0	0	0	3.	0	0	.5	.5	0	37.5	54.
v 5	a-c	0	.5	0	0	0	0	0	0	.5	0	0	.5	0	0	8.	3.
x 26	a-c	0	0	0	0	15.	.5	0	0	.5	0	0	.5	.5	0	46.	46.
	-- Clearcut with broadcast burning 13-23 years ago (10 pairs)																
v 4	a-c	0	.5	0	0	3.	0	15.	22.	0	0	.5	3.	.5	0	37.5	28.
x 10	a-c	0	.5	0	.5	.5	.5	0	0	0	0	.5	.5	.5	0	72.	15.
x 19	a-d	.5	.5	0	0	.5	0	0	0	0	0	0	.5	0	0	62.5	22.
x 27	a-c	0	.5	0	0	22.	0	3.	0	.5	0	.5	.5	0	0	37.5	3.
x 9	a-d	.5	.5	0	0	0	0	0	.5	.5	0	.5	.5	.5	0	72.	.5
x 11	a-d	0	.5	0	0	37.5	3.	0	0	.5	0	0	.5	.5	0	3.	3.
v 1	a-b	0	.5	0	0	0	0	.5	.5	.5	0	0	.5	0	0	46.	46.
v 2	a-c	0	0	0	0	0	0	0	0	.5	0	0	0	0	0	37.5	22.
x 14	a-d	0	0	0	0	.2	.5	0	8.	.5	0	0	.5	0	0	85.	62.5
x 24	a-d	0	.5	0	15.	.5	.5	0	0	.5	0	0	22.	.5	0	72.	3.
	-- Wildfire (stand-replacing) 17-30 years ago (5 pairs)																
x 22	a-c	0	.5	0	0	0	.5	0	.5	.5	0	0	.5	.5	0	3.	.5
x 21	a-b	0	0	0	.5	.5	0	0	0	.5	0	0	.5	.5	0	8.	.5
x 16	a-b	0	.5	0	.2	.5	.5	0	0	.5	0	0	.5	0	0	46.	46.
x 24	a-b	0	.5	0	8.	.5	3.	0	0	.5	0	0	3.	.5	0	72.	37.5
x 19	a-b	.5	0	0	0	.5	3.	0	0	0	.5	0	.5	0	0	62.5	8.
	-- Wildfire (stand-replacing) 41-68 years ago (9 pairs)																
x 7	a-b	0	0	0	0	8.	0	0	0	2.	0	0	.5	0	0	72.	62.5
x 8	a-b	0	.2	0	.5	.5	.5	0	0	.5	0	0	.5	0	0	3.	3.
x 18	a-b	0	0	0	0	.5	0	0	0	0	0	0	.5	0	0	37.5	46.
x 5	a-b	0	0	0	0	.5	.5	0	0	.5	0	0	0	.5	0	85.	62.5
x 28	a-b	0	0	0	0	8.	3.	0	0	3.	.5	0	0	.5	.5	37.5	22.
v 3	a-b	0	0	0	0	0	0	0	0	0	.5	0	.5	0	0	.5	.5
v 2	a-b	0	0	0	0	0	0	0	0	.5	.5	0	.5	0	.5	37.5	37.5
x 6	a-b	0	0	0	0	46.	54.	.5	.5	3.	.5	.5	.5	.5	.5	3.	8.
x 10	a-b	0	0	0	0	.5	8.	0	0	0	.5	.5	0	.5	.5	72.	37.5
	-- Wildfire (stand-replacing) 74-105 years ago (10 pairs)																
x 29	a-b	0	0	0	0	22.	37.5	.5	.5	.5	.5	0	0	0	0	15.	37.5
v 4	a-b	0	0	0	0	3.	15.	15.	8.	0	0	.5	.5	.5	.5	37.5	62.5
x 9	a-b	.5	0	0	0	0	.5	0	0	.5	.5	.5	.5	.5	0	72.	62.5
x 13	a-b	0	0	0	0	22.	.5	.5	.5	0	.5	0	.5	.5	.5	37.5	37.5
x 2	a-b	0	0	0	0	.5	.5	0	0	.5	.5	0	0	0	0	37.5	37.5
x 1	a-b	0	0	0	0	22.	15.	0	0	3.	2.	0	0	.5	.5	46.	62.5
x 14	a-b	0	0	0	0	.2	0	0	.5	.5	.5	0	.5	0	0	85.	46.
x 11	a-b	0	0	0	0	37.5	22.	0	0	.5	0	0	0	.5	.5	3.	62.5
v 6	a-b	0	0	0	0	0	0	0	0	.5	8.	.5	.5	.5	.5	.5	.5
x 26	a-b	0	0	0	0	15.	15.	0	0	.5	3.	0	0	.5	.5	46.	72.

Appendix B. Percent canopy coverage for principal undergrowth species in all paired (untreated vs. treated) sample stands in the *Pseudotsuga/Physocarous* habitat type in west-central Montana. Stand pairs are grouped into 8 treatment type and age-since-treatment categories (same as Table 2). U = untreated, T = treated; species names are spelled out in Table 2.

Site No.	Plot Letter	Abbreviated species names																	
		ACGL		AMAL		CEVE		PHMA		SASC		SPBE		SYAL		VAGL	
	U T	U	T	U	T	U	T	U	T	U	T	U	T	U	T	U	T
Clearcut with no site preparation 4-15 years ago (8 pairs)																	
28	a-d	0	0	2.	4.	0	.5	3.	62.5	0	0	2.	8.	2.	15.	0	0
13	a-b	8.	.5	.5	3.	0	0	72.	46.	0	.2	.5	0	22.	15.	0	0
5	a-c	3.	.5	.5	4.	0	0	78.	78.	.5	3.	.5	8.	8.	22.	0	0
8	a-b	0	0	3.	8.	0	0	15.	22.	0	.2	3.	2.	4.	15.	8.	.5
9	a-b	0	0	3.	8.	0	0	37.5	46.	0	0	0	0	3.	22.	0	0
25	a-c	.5	8.	2.	8.	0	0	37.5	15.	0	3.	8.	.5	.5	.5	0	0
33	a-b	0	.5	2.	.5	0	0	15.	62.5	0	0	3.	8.	15.	15.	0	0
18	a-c	0	0	8.	.5	0	0	37.5	22.	0	.5	.5	0	0	0	0	0
Clearcut with no site preparation 20-28 years ago (4 pairs)																	
26	a-b	0	.5	.5	15.	0	0	15.	22.	.5	4.	22.	46.	3.	3.	0	0
22	a-c	0	0	2.	.5	0	.2	72.	62.5	0	0	0	0	0	0	0	0
24	a-b	.2	.2	3.	22.	0	22.	46.	22.	0	0	3.	3.	0	37.5	0	0
14	a-b	0	.5	.5	3.	0	0	46.	54.	0	.2	8.	15.	3.	3.	0	0
Clearcut with mechanical scarification (± burning) 14-28 years ago (7 pairs)																	
25	a-d	.5	4.	2.	3.	0	.2	37.5	8.	0	2.	8.	28.	.5	.5	0	0
34	a-b	0	0	1.	2.	0	0	15.	54.	0	0	37.5	15.	0	3.	0	0
10	a-b	0	0	8.	2.	0	.5	15.	8.	0	3.	3.	8.	.5	.5	8.	.5
17	a-d	1.	0	3.	3.	0	4.	54.	15.	0	0	.5	3.	.5	.5	0	0
30	a-b	0	0	2.	4.	0	4.	37.5	37.5	0	.5	2.	15.	46.	62.5	0	0
21	a-b	0	0	4.	3.	0	.5	22.	72.	0	0	.5	0	8.	0	0	0
24	a-c	.2	0	3.	3.	0	85.	46.	2.	0	2.	3.	.5	0	.5	0	0
Clearcut with broadcast burning 4-23 years ago (5 pairs)																	
12	a-b	0	0	3.	3.	0	8.	85.	46.	0	0	0	0	3.	37.5	0	0
1	a-b	8.	8.	37.5	37.5	0	0	37.5	15.	0	0	.5	.5	8.	8.	0	0
2	a-c	.2	.5	.5	8.	0	0	46.	46.	0	.5	2.	8.	2.	.5	5.	0
27	a-c	0	2.	.5	22.	0	.5	46.	46.	0	0	0	.5	.5	28.	0	0
23	a-b	3.	8.	3.	4.	0	.5	22.	22.	.5	4.	15.	.5	.5	0	0	0
Wildfire (stand-replacing) 5 years ago (3 pairs)																	
6	a-b	8.	15.	15.	8.	.5	.5	46.	72.	0	0	.5	8.	15.	8.	0	0
11	a-b	0	.5	3.	3.	0	.5	37.5	28.	0	0	3.	62.5	15.	15.	0	0
11	c-d	37.5	15.	8.	15.	3.	72.	54.	15.	0	0	0	.5	.5	22.	0	0
Wildfire (stand-replacing) 32-48 years ago (5 pairs)																	
31	a-b	0	0	2.	28.	.5	37.5	15.	46.	0	0	0	0	22.	22.	0	0
2	a-b	.2	.2	.5	3.	0	0	46.	46.	0	.5	2.	46.	2.	0	.5	0
17	a-c	1.	0	3.	8.	0	.5	54.	46.	0	0	.5	15.	.5	.5	0	0
35	a-b	3.	15.	3.	3.	.5	37.5	22.	72.	0	0	0	0	8.	.5	0	0
32	a-b	0	0	3.	28.	.5	37.5	62.5	54.	0	0	.5	.5	.5	0	0	0
Wildfire (stand-replacing) 58-67 years ago (13 pairs)																	
5	a-b	3.	22.	.5	3.	0	0	78.	8.	.5	3.	.5	.5	8.	3.	0	0
15	a-b	0	.2	2.	8.	0	0	22.	15.	0	3.	.5	.5	0	0	0	0
15	a-c	0	0	2.	8.	0	28.	22.	62.5	0	0	.5	3.	0	0	0	0
16	a-b	2.	15.	4.	2.	3.	0	72.	46.	0	3.	0	.5	2.	0	0	0
18	a-b	0	0	8.	4.	0	0	37.5	8.	0	2.	.5	.5	0	.5	0	0
20	a-b	0	0	15.	37.5	0	0	62.5	46.	.5	3.	.5	.5	.5	.5	0	0
3	a-b	0	3.	2.	8.	0	.5	28.	28.	0	8.	0	0	.5	22.	0	0
4	a-b	8.	22.	15.	3.	0	0	62.5	46.	3.	22.	.5	.5	.5	.5	0	0
11	a-c	0	37.5	3.	8.	0	3.	37.5	54.	0	0	3.	0	15.	.5	0	0
12	a-c	0	4.	3.	.5	0	.5	85.	46.	0	0	0	0	3.	37.5	0	0
28	a-b	0	0	2.	37.5	0	0	3.	4.	0	3.	2.	3.	2.	.5	0	0
28	a-c	0	0	2.	15.	0	.2	3.	62.5	0	8.	2.	3.	2.	2.	0	0
29	a-b	0	0	8.	28.	.5	0	85.	22.	0	0	15.	.5	.5	.5	0	0
Wildfire (stand-replacing) 78-90 years (3 pairs)																	
27	a-b	0	2.	.5	8.	0	3.	46.	62.5	0	0	0	.5	.5	2.	0	0
22	a-b	0	0	2.	3.	0	0	72.	72.	0	0	0	0	0	.5	0	0
25	a-b	.5	8.	2.	15.	0	0	37.5	8.	0	0	8.	3.	.5	2.	0	0

Appendix B. Continued (p. 2)

Site No.	Plot Letter	Abbreviated species names BERE		AGSP		CARU		CAGE		ARCO		ASCO		GOOB	
		U	T	U	T	U	T	U	T	U	T	U	T	U	T
	Clearcut with no site preparation 4-15 years ago (8 pairs)														
28	a-d	.5	.5	0	.2	72.	28.	.5	28.	.5	0	.5	.5	.5	0
13	a-b	.5	.5	0	0	.5	54.	46.	15.	0	0	.5	1.	.5	0
5	a-c	3.	.5	0	0	15.	15.	22.	15.	0	.5	.5	3.	0	0
8	a-b	.5	.5	0	0	3.	28.	62.5	46.	0	0	.5	0	.5	0
9	a-b	0	.5	15.	22.	0	0	46.	46.	0	0	.5	0	0	0
25	a-c	.5	.5	0	0	62.5	46.	0	0	.5	.5	.5	.5	.5	0
33	a-b	.5	.5	0	0	62.5	85.	0	0	3.	0	.5	15.	.5	0
18	a-c	0	0	3.	.5	37.5	72.	15.	4.	4.	.5	0	0	.5	0
	Clearcut with no site preparation 20-28 years ago (4 pairs)														
26	a-b	0	.5	0	0	46.	37.5	8.	62.5	3.	.5	.5	.5	1.	.5
22	a-c	.5	.5	15.	4.	46.	3.	46.	28.	0	0	0	0	0	0
24	a-b	.5	3.	0	0	46.	.5	46.	37.5	0	0	0	.5	0	0
14	a-b	3.	.5	0	0	15.	15.	.5	.5	0	0	0	.5	.5	.5
	Clearcut with mechanical scarification (± burning) 14-28 years ago (7 pairs)														
25	a-d	.5	.5	0	0	62.5	3.	0	0	.5	0	.5	.5	.5	0
34	a-b	.5	.5	3.	.5	37.5	3.	0	15.	.5	0	.5	4.	0	0
10	a-b	.5	.5	0	0	92.	37.5	.5	3.	0	0	.5	.5	.5	0
17	a-d	.5	.5	0	0	37.5	22.	2.	37.5	0	0	2.	2.	0	0
30	a-b	0	0	0	0	22.	62.5	.5	.5	22.	0	.5	.5	.5	0
21	a-b	.5	0	.5	15.	85.	15.	3.	37.5	0	0	0	0	0	0
24	a-c	.5	0	0	0	46.	3.	46.	15.	0	0	0	0	0	0
	Clearcut with broadcast burning 4-23 years ago (5 pairs)														
12	a-b	.5	3.	.5	.5	28.	37.5	15.	4.	0	0	.5	.5	.5	0
1	a-b	.5	.5	3.	8.	0	0	22.	22.	0	0	0	0	0	0
2	a-c	5.	.5	0	0	22.	46.	.5	3.	0	.5	.5	.5	.5	0
27	a-c	.5	.5	0	.5	62.5	15.	15.	54.	.5	0	0	.5	0	0
23	a-b	.5	.5	0	0	85.	15.	3.	0	0	0	3.	3.	.5	.5
	Wildfire (stand-replacing) 5 years ago (3 pairs)														
6	a-b	.5	.5	.5	.5	.5	22.	54.	3.	0	0	.5	.5	0	0
11	a-b	4.	.5	0	0	15.	.5	72.	15.	0	0	.5	3.	0	0
11	c-d	3.	2.	0	0	8.	8.	54.	22.	0	0	.5	.5	0	0
	Wildfire (stand-replacing) 32-48 years ago (5 pairs)														
31	a-b	3.	3.	0	0	22.	.5	46.	54.	.5	0	.5	0	0	0
2	a-b	.5	0	0	0	22.	28.	.5	.5	0	0	.5	.5	.5	0
17	a-c	.5	.5	0	0	37.5	46.	2.	46.	0	0	2.	3.	0	0
35	a-b	2.	.5	2.	.5	54.	3.	37.5	46.	0	0	.5	3.	.5	0
32	a-b	.5	15.	3.	3.	46.	8.	15.	46.	.5	0	0	0	0	0
	Wildfire (stand-replacing) 58-67 years ago (13 pairs)														
5	a-b	3.	.5	0	0	15.	.5	22.	.5	0	0	.5	.5	0	0
15	a-b	.5	8.	0	0	85.	46.	.5	0	0	0	0	2.	0	.5
15	a-c	.5	.5	0	.5	85.	.5	.5	62.5	0	0	0	0	0	0
16	a-b	2.	.5	37.5	0	22.	4.	37.5	2.	0	0	0	0	0	0
18	a-b	0	0	3.	0	37.5	37.5	15.	.5	4.	.5	0	.5	.5	0
20	a-b	.5	.5	0	0	92.	15.	.5	0	0	0	.5	.5	0	0
3	a-b	.5	.5	0	.5	8.	3.	37.5	15.	0	0	0	0	0	0
4	a-b	0	0	0	0	22.	28.	4.	.5	.5	0	.5	.5	0	0
11	a-c	4.	3.	0	0	15.	8.	72.	54.	0	0	.5	.5	0	0
12	a-c	.5	8.	.5	0	28.	.5	15.	37.5	0	0	.5	.5	.5	0
28	a-b	.5	0	0	0	72.	22.	.5	0	.5	0	.5	.5	.5	.5
28	a-c	.5	0	0	0	72.	46.	.5	15.	.5	0	.5	.5	.5	.5
29	a-b	0	.5	0	0	.5	.5	62.5	46.	0	0	0	0	0	0
	Wildfire (stand-replacing) 78-90 years (3 pairs)														
27	a-b	.5	2.	0	0	62.5	37.5	15.	37.5	.5	0	0	.5	0	0
22	a-b	.5	22.	15.	0	46.	8.	46.	.5	0	0	0	0	0	.5
25	a-b	.5	.5	0	0	62.5	72.	0	0	.5	0	.5	.5	.5	.5

PART B:

HYPOTHESIZED SUCCESSIONAL PATTERNS OF TREE SPECIES ON THE PSEUDOTSUGA PHYSOCARPUS AND ABIES LASIOCARPA/XEROPHYLLUM HABITAT TYPES IN WESTERN MONTANA AFTER VARIOUS TYPES OF TREATMENTS

This is a brief explanation of the patterns hypothesized in the accompanying figures. These figures are based upon two seasons of field sampling in paired (treated versus untreated) stands occurring side by side on the same sites, as well as upon detailed fire history studies (Arno 1976, 1979).

I. Pseudotsuga/Physocarpus habitat type, dry phase

Natural Succession with Natural Fire

Figure A shows a typical pattern of tree succession in a pre-settlement stand in the dry phase of the Pseudotsuga/Physocarpus habitat type. Low to medium intensity ground fires at 10- to 30-year intervals continually favored ponderosa pine (PP) by differentially killing a high proportion of the Douglas-fir (DF) regeneration. Ponderosa pine saplings have thicker bark and less foliage near the ground; thus, they are less vulnerable to light fires than Douglas-firs of comparable age. This fire regime maintained ponderosa pine as the major overstory component, resulting in park-like stands of large ponderosa pine (many age classes) with a relatively open understory.

Natural Succession with Fire Suppression

Figure B-1 represents the succession that typically occurs with fire suppression in the same type of primeval stand. After about 50 years without fire, Douglas-fir has become the understory dominant because of its greater shade tolerance. Ponderosa pine fails to regenerate and replace itself; thus, the stand is converted to nearly pure Douglas-fir by age 300.

Catastrophic Fire Event on B-1

A variation on the above theme is shown in Figure B-2. The dense growth of understory Douglas-fir forms a fuel ladder that allows a wildfire to crown out and destroy the stand in year 90. In the fire's aftermath, Douglas-firs, having lighter seeds that disperse readily from adjacent stands, regenerate more abundantly than ponderosa pine; thus, a Douglas-fir forest develops after the crownfire.

Selection Cutting Without Burning

(Speed-up of Natural Succession)

Figures C, D and E show the results of some contrasting silvicultural techniques. First (Figure C-1), is a series of selection cuts in which the large ponderosa pines are favored for harvest because of their high value. The first cut is made 40 years after the last understory fire. Since no appreciable site preparation or burning accompanies the cuts, the result is that Douglas-fir regeneration is favored by the cutting techniques. Succession to Douglas-fir forest is accelerated by this type of cutting in the absence of understory fire. Figure C-2 shows the result of such treatments if the first selection cut was made about 25 years later, when the understory was already dominated by Douglas-fir.

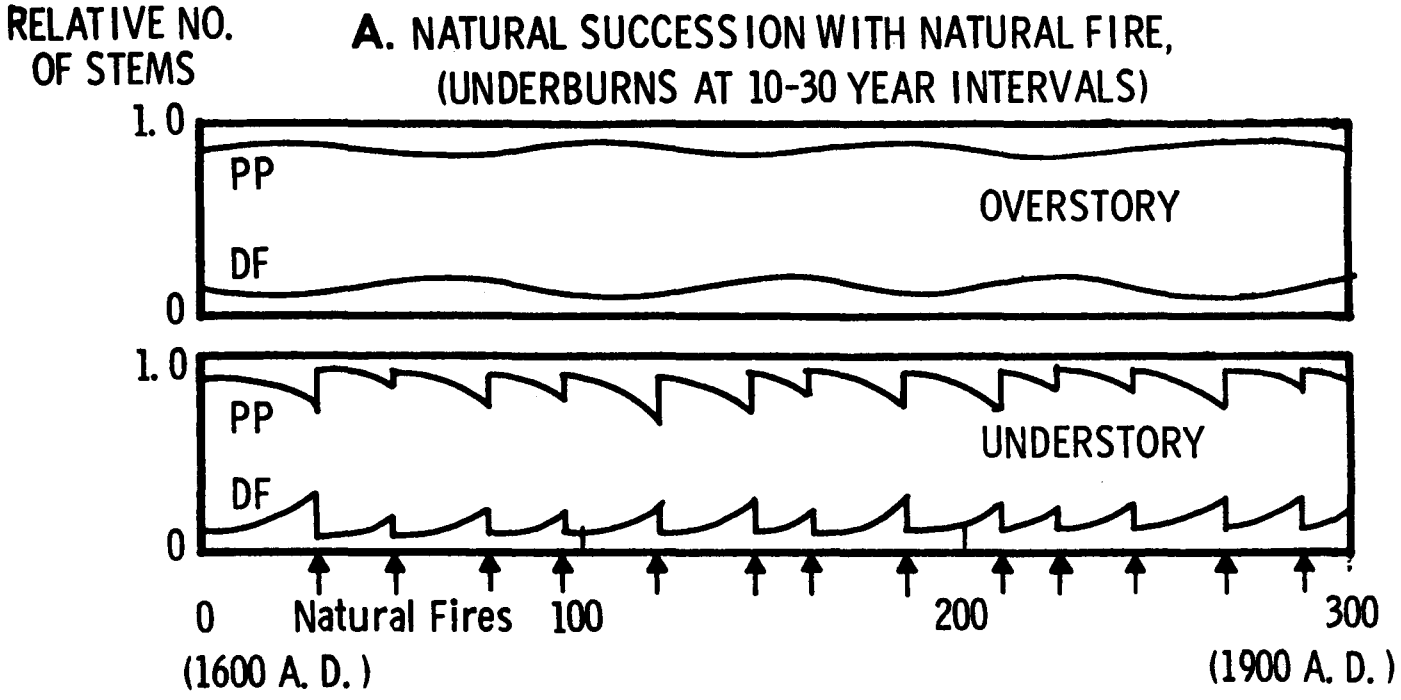
Clearcutting

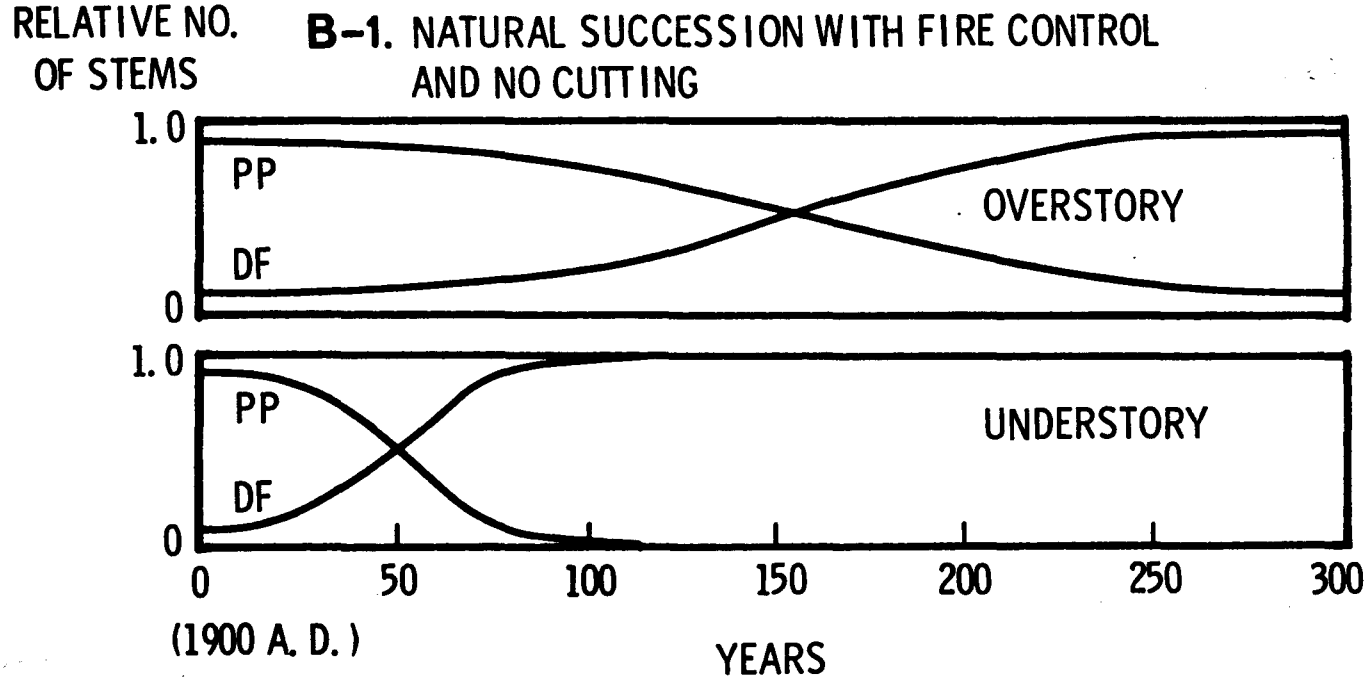
Next (Figure D), we see the results of clearcut-broadcast burn treatments made every 100 years, starting 65 years after the last understory fire. The burning exposes mineral soil and is thus favorable for ponderosa pine as well as Douglas-fir regeneration. However, Douglas-fir regenerates best because of its more abundant seed dispersal from adjacent stands; thus, this treatment also favors succession to a Douglas-fir forest. When ponderosa pine seed trees were left, this successional trend is usually slowed, but not arrested.

Selection Cutting with Underburning

Finally, Figure E shows the probable effect of partial cuts and prescribed underburns intended to favor regeneration of ponderosa pine. The stand-opening cuts and site-preparing burns were begun 80 years after the last understory wildfire. Larger proportions of understory Douglas-fir are killed than ponderosa pine with each treatment; thus, the result is a silviculturally-perpetuated PP-DF forest that closely resembles the pre-settlement situation (Figure A).

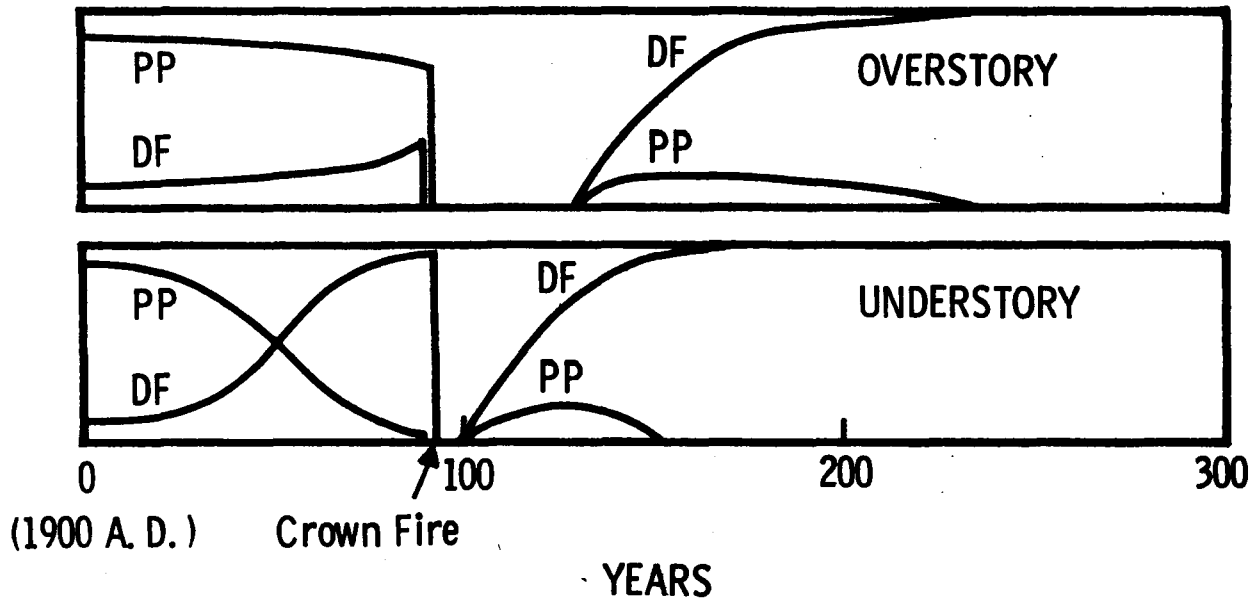
Successional patterns of Tree species on the Pseudotsuga/ Physocarpus habitat type, dry phase, in Western Montana; after various types of treatment.

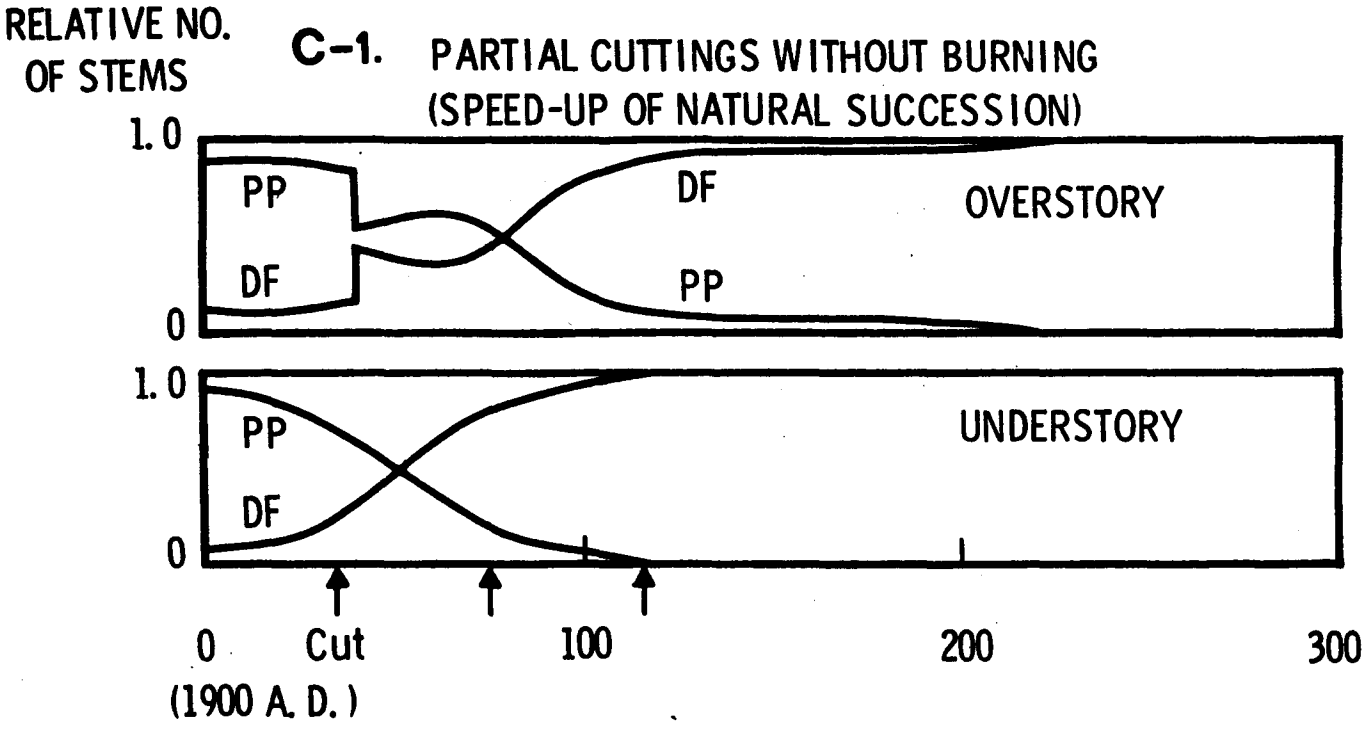


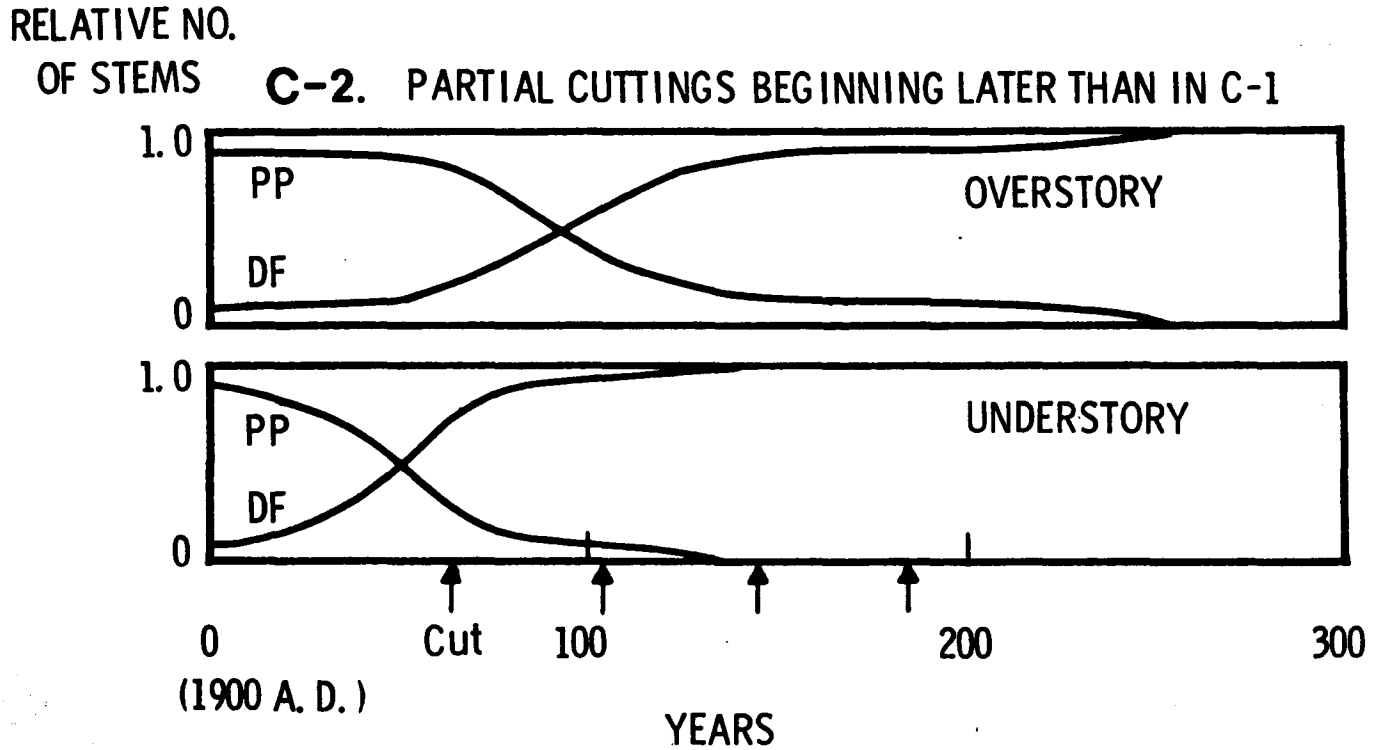


ABSOLUTE NO.
OF STEMS

B-2. CATASTROPHIC FIRE EVENT ON B-1

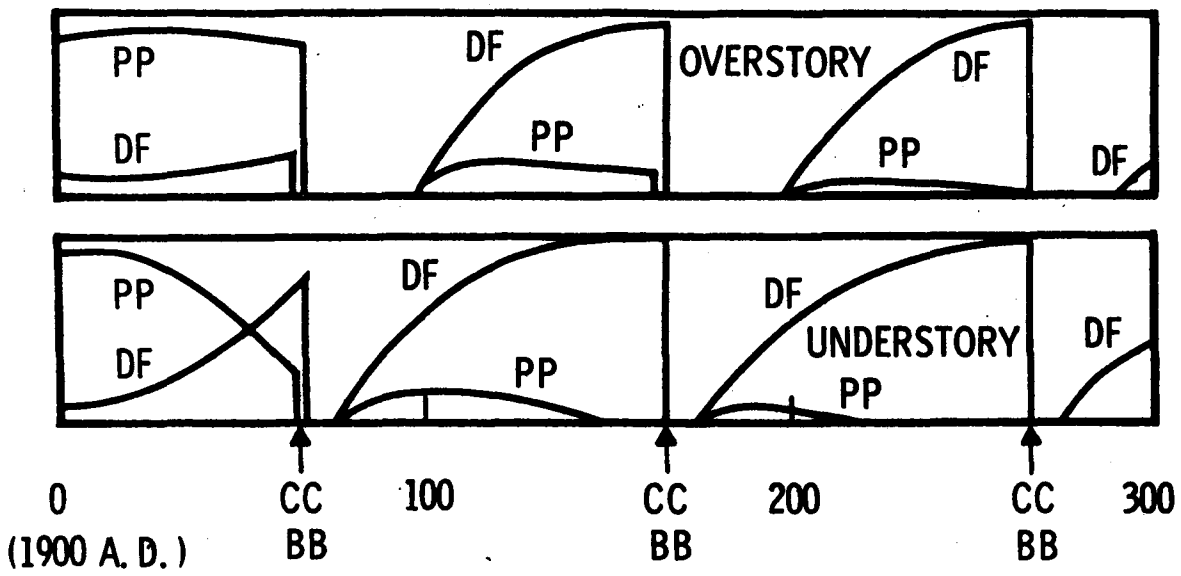



RELATIVE NO. OF STEMS
C-1. PARTIAL CUTTINGS WITHOUT BURNING
(SPEED-UP OF NATURAL SUCCESSION)
1.0
PP
DF
DF
PP
OVERSTORY
0
1.0
PP
DF
UNDERSTORY
0
0
Cut
100
200
300
(1900 A. D.)


RELATIVE NO. OF STEMS
C-2. PARTIAL CUTTINGS BEGINNING LATER THAN IN C-1
1.0
PP
DF
OVERSTORY
0
1.0
PP
DF
UNDERSTORY
0
0
Cut
100
200
300
(1900 A. D.)
YEARS

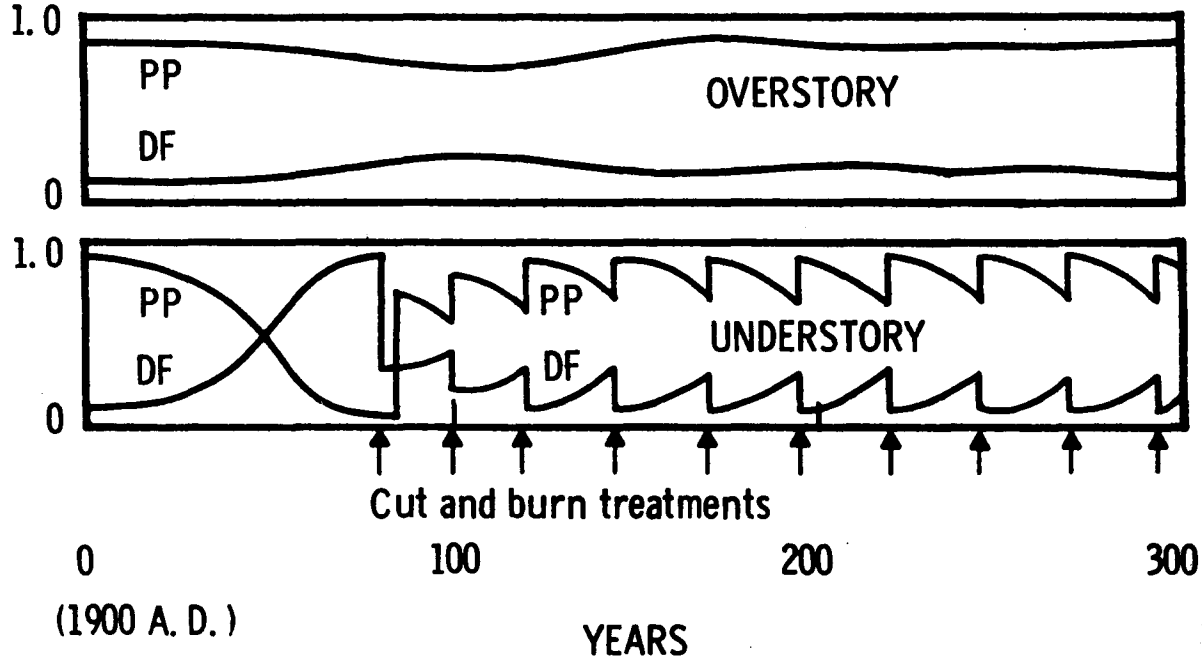
ABSOLUTE NO.
OF STEMS

D. CLEARCUTTING WITH BROADCAST-BURNING
AT 100 YEAR INTERVALS



RELATIVE NO.
OF STEMS

E. SELECTION SYSTEM TO FAVOR PONDEROSA PINE
AND PRESCRIBED UNDERBURNS



II. Pseudotsuga/Physocarpus h.t., moist phase

Natural Succession with Natural Fire

Figure A shows a typical pattern of tree succession in a pre-settlement stand in the moist phase of the Pseudotsuga/Physocarpus h.t. Low to medium intensity ground fires occurred at 20 to 60-year intervals in many stands, continually favoring western larch (L) and ponderosa pine (PP) by differentially killing a high proportion of the Douglas-fir (DF) regeneration. Larch and ponderosa pine saplings are less vulnerable to light fires than Douglas-firs of comparable age. This fire regime maintained mixed open stands of large larch, Douglas-fir, and ponderosa pine with a patchy regeneration layer. Lodgepole pine usually is only a minor component of this h.t. and will be ignored for purposes of these illustrations.

Natural Succession with Fire Suppression

Figure B-1 represents the succession that typically occurs with fire suppression in the same type of primeval stand. After about 50 years without fire, Douglas-fir has become the understory dominant because of its greater shade tolerance. Larch and ponderosa pine fail to regenerate and replace themselves; thus, the stand is converted to nearly pure Douglas-fir by year 300.

Catastrophic Fire Event on B-1

Figure B-2 shows a variation on the above patterns. In this case, the stand had no fire (or logging) for an unusually long period of 90 years. At this point a wildfire occurred, and it spread upward through the dense "fuel ladder" of Douglas-fir understory, crowning and destroying all but a few of the overstory larch trees. Afterwards, larch and Douglas-fir, having lighter seeds that disperse readily from adjacent stands, regenerated much more abundantly than the heavy seeded ponderosa pine.

Partial Cutting Without Burning

(Speed-up of Natural Succession)

The probable effects of economically motivated (not silviculturally based) partial cuttings are shown in Figure C-1. Larch and ponderosa pine are favored for cutting. No appreciable site preparation is done,

and only minor opening of the canopy occurs; thus, larch and pine fail to regenerate. Douglas-fir regenerates and fills in available space; thus, natural succession is accelerated.

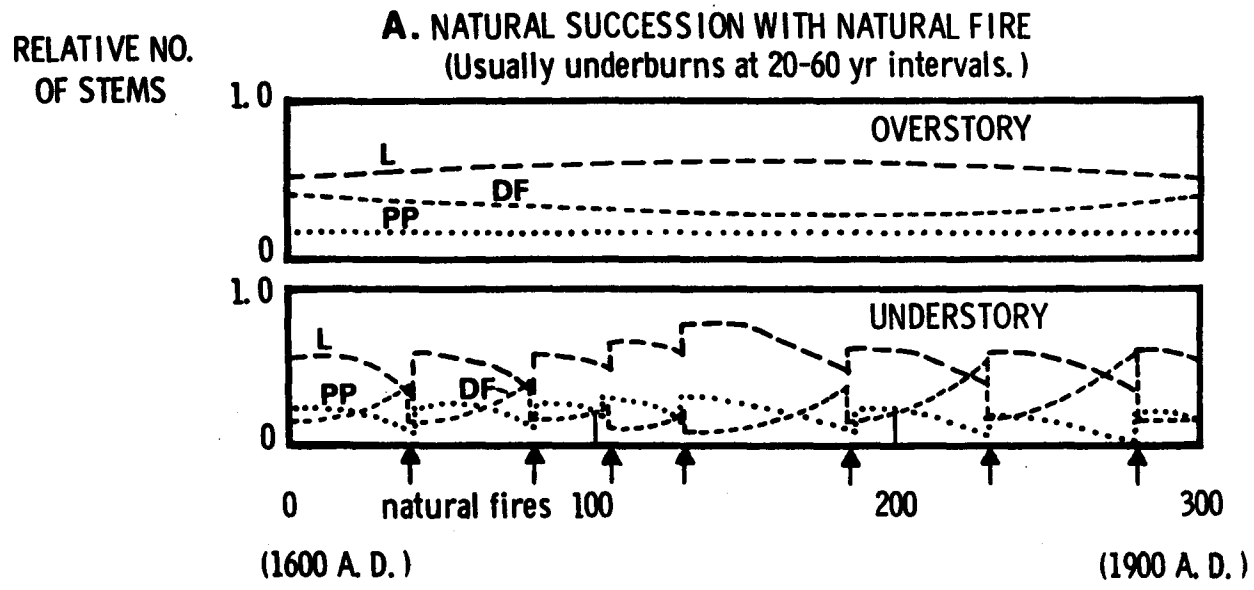
Clearcutting

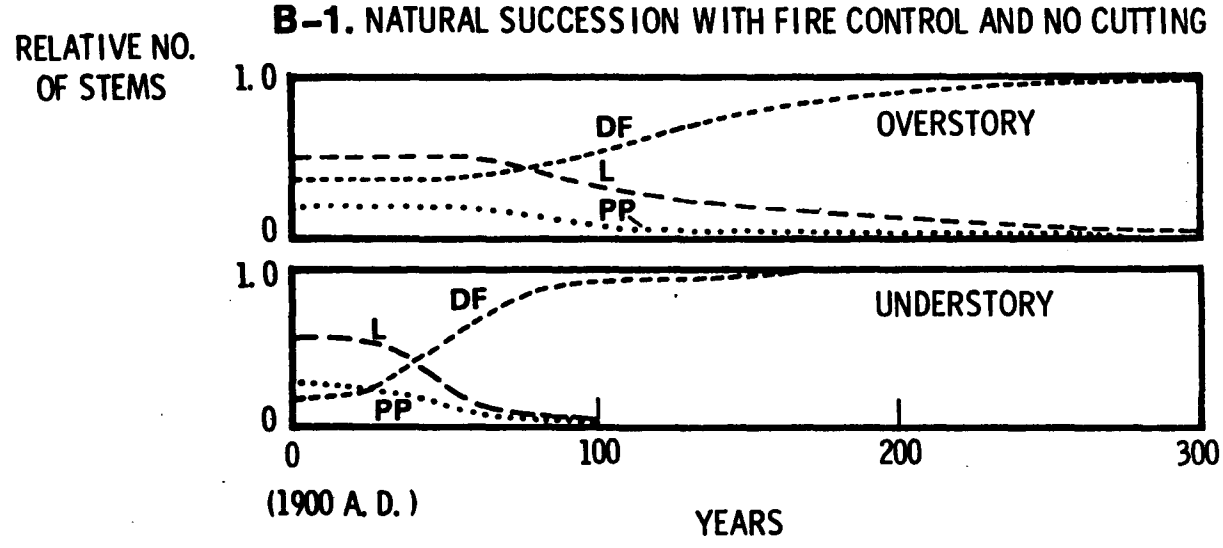
Figure D shows probable effects of clearcut-broadcast burn treatments made every 100 years, starting 65 years after the last understory fire. The burning exposes mineral soil and is thus favorable for regeneration of all species; however, the light seeded larch is the primary beneficiary. Douglas-fir regains its former abundance, while the heavy seeds of ponderosa pine do not disperse well and thus this species diminishes in importance. Leaving seed trees of larch and ponderosa pine should generally improve regeneration of those species relative to Douglas-fir.

Selection System with Prescribed Underburns

Figure E shows the hypothesized effects of a silvicultural system of selection cuts and prescribed underburns intended to favor regeneration of larch and ponderosa pine. The stand-opening cuts and site-preparing burns were begun 80 years after the last understory wildfire. Larger proportions of understory Douglas-fir are killed than larch or ponderosa pine with each treatment and, unlike clearcuts or stand-destroying fires, this treatment retains a ponderosa pine seed source. The result is a silviculturally perpetuated L-DF-PP forest that resembles the presettlement situation (Figure A).

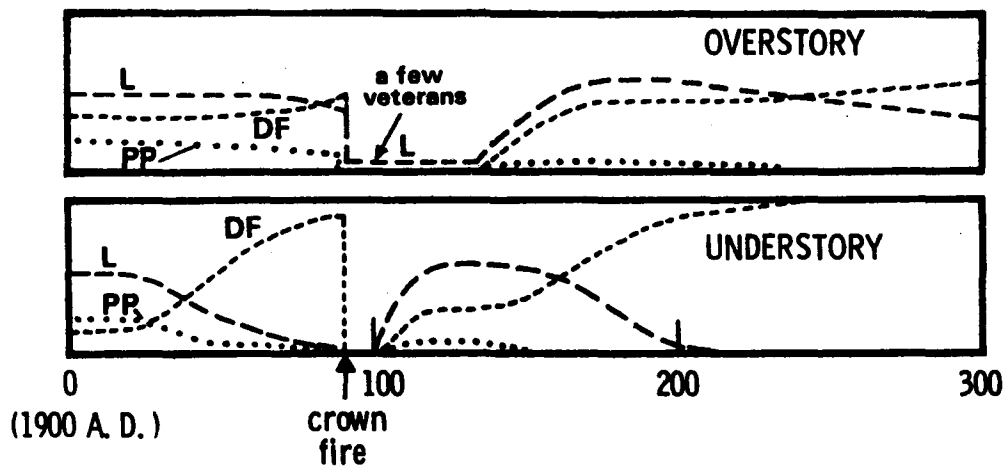
HYPOTHETICAL PATTERNS OF TREE SPECIES SUCCESSION ON THE PSEUDOTSUGA/ PHYSOCARPUS H.T., (MOIST PHASE), IN WESTERN MONTANA, AFTER VARIOUS TYPES OF TREATMENTS.





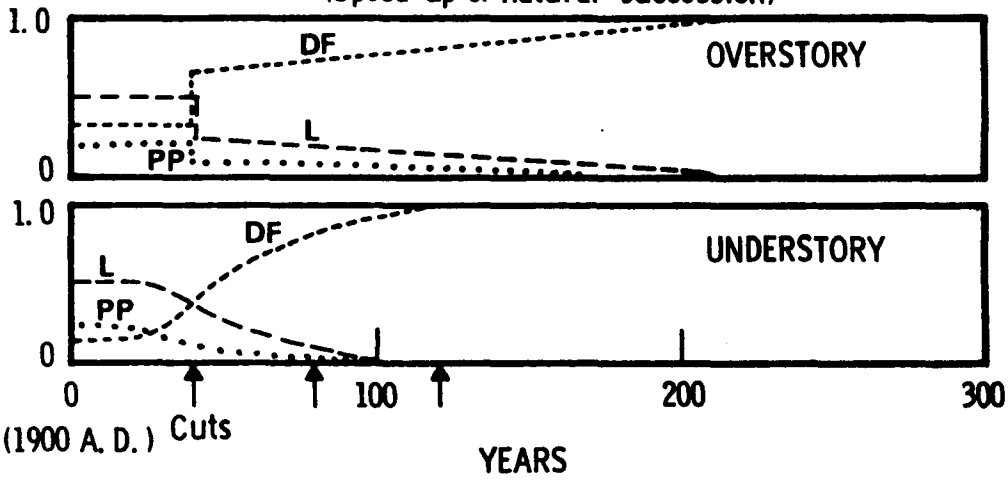
ABSOLUTE NO.
OF STEMS

B-2. CATASTROPHIC FIRE EVENT ON B-1



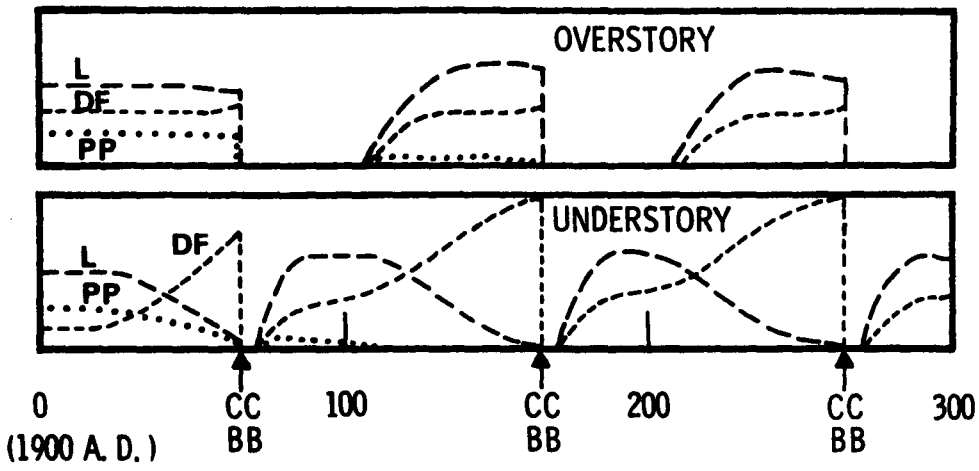
RELATIVE NO.
OF STEMS

C-1. PARTIAL CUTTINGS WITHOUT BURNING
(Speed-up of natural succession)



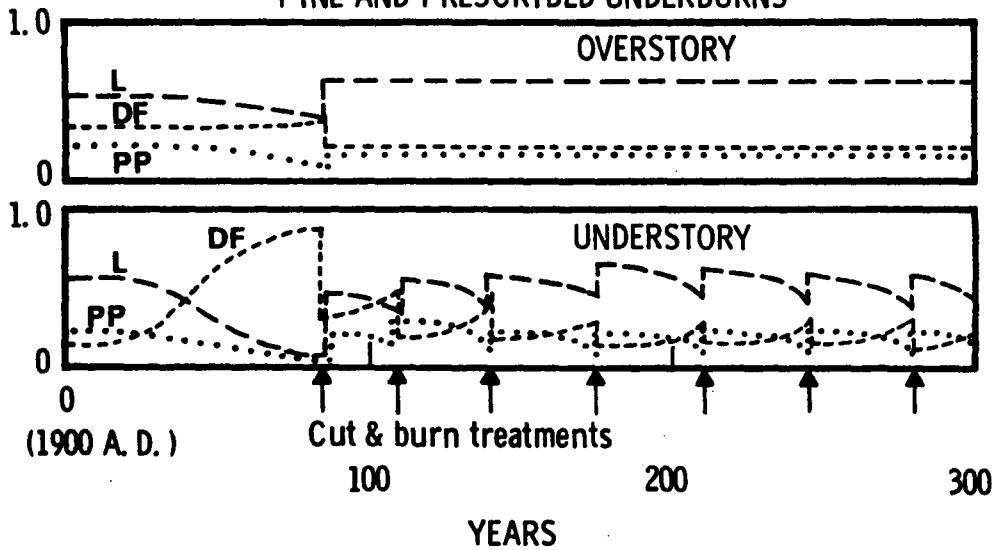
ABSOLUTE NO.
OF STEMS

D. CLEARCUTTING WITH BROADCAST-BURNING
AT 100 YEAR INTERVALS



RELATIVE NO.
OF STEMS

E. SELECTION SYSTEM TO FAVOR LARCH AND PONDEROSA
PINE AND PRESCRIBED UNDERBURNS



III. Abies lasiocarpa/Xerophyllum, warm phase

Natural Succession with Natural Fire

Figure A shows a typical pattern of tree succession in a pre-settlement stand in the warm phase of the Abies lasiocarpa/Xerophyllum h.t. Both stand-replacing fires and low to medium intensity ground fires occurred at various intervals. Lodgepole pine (LP) and western larch (L) were favored by fire treatments, as was Douglas-fir (DF) to a lesser extent. Subalpine fir (AF), a slow-growing shade-tolerant species, is killed by even low intensity fires and requires more than a century to regain dominance after fire. As Figure A indicates, most pre-settlement stands had overstories composed primarily of Douglas-fir and lodgepole pine, with lesser amounts of larch. Understories contained variable amounts of subalpine fir, in addition to the other species. Underburning perpetuated open stands of large Douglas-fir and larch (sometimes with ponderosa pine on the warmest sites). Stand-replacing fires favored lodgepole pine.

Natural Succession with Fire Suppression

Figure B-1 represents the successional pattern that typically occurs with prolonged fire suppression in the same type of primeval stand. Lodgepole pine and larch fail to regenerate, allowing Douglas-fir to become the overstory cominant 125 to 150 years after the last fire. Subalpine fir becomes the dominant understory and eventually becomes a co-dominant in the overstory with Douglas-fir.

Partial Cutting Without Burning (Speedup of Natural Suppression)

The probable effects of economically motivated partial cuttings are shown in Figure C-1. The initial stand is equivalent to the 150 year old stand shown in Figure B-1. Partial cuttings remove much of the larch and lodgepole pine and, without site preparation, these species fail to regenerate beneath the residual stand. Douglas-fir is initially favored for harvest over subalpine fir, until the latter becomes the stand dominant. Douglas-fir is able to regenerate moderately in response to the stand-opening cuts, but subalpine fir continues to regenerate also.

Clearcutting

Figure D shows probable effects of clearcut-broadcast burn treatments made every 120 years, starting with a stand comparable to that in Figure C-1. This treatment is most favorable for lodgepole pine and larch, and thus they increase relative to Douglas-fir through successive rotations. On relatively dry sites larch will remain uncommon. Subalpine fir remains a minor understory component.

Selection System With Prescribed Underburns

Figure E shows the hypothesized effects of silvicultural system of selection cuts and prescribed underburns intended to favor larch and Douglas-fir. The stand-opening cuts and site-preparing burns were begun on a stand comparable to that in Figures C-1 and D. The cut and burn treatment is made at intervals of about 50 to 60 years, when some of the larger larch and Douglas-fir regeneration resulting from the previous cut will survive the underburn and thus replenish the overstory. Nearly all of the understory lodgepole pine and subalpine fir will be killed by each underburn; thus, the resulting stand is dominated by larch and Douglas-fir.

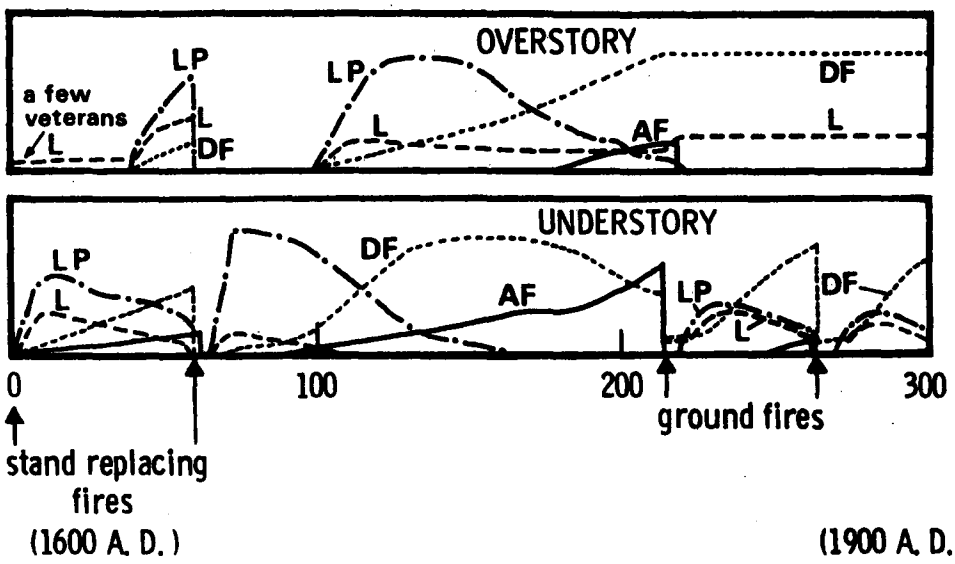
Selection System Without Underburns

Figure F shows the hypothesized effects of a silvicultural system of selection cuts without underburns, made to favor Douglas-fir. The cuts are made at 40-year intervals. All commercial size subalpine fir overstory trees are harvested with each cutting in order to remove this seed source. Douglas-fir regeneration is benefited by the stand-opening cuts and skid trails, and this species' faster growth enables it to maintain overstory dominance over subalpine fir, with continued cutting treatments.

HYPOTHETICAL PATTERNS OF TREE SPECIES SUCCESSION ON THE ABIES LASIOCARPA/ XEROPHYLLUM H.T., (WARM PHASE), IN WESTERN MONTANA, AFTER VARIOUS TYPES OF TREATMENTS.

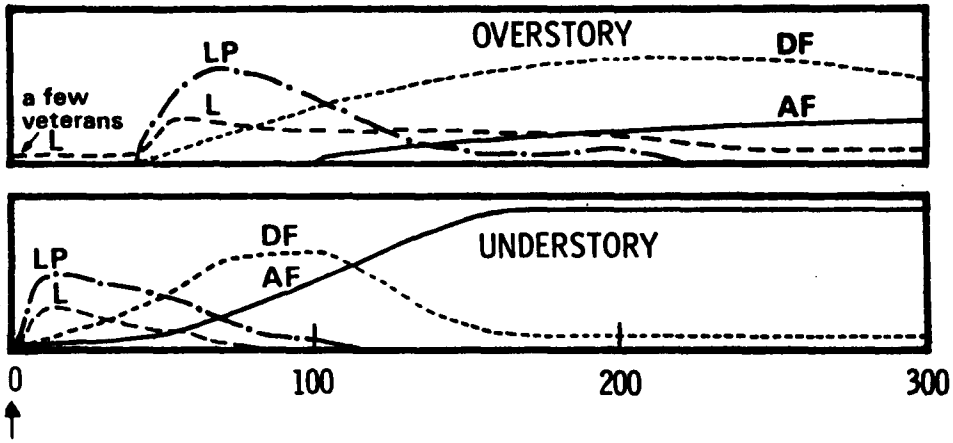
ABSOLUTE NO. OF STEMS

A. NATURAL SUCCESSION WITH NATURAL FIRE
(Some stand replacement fires and some underburns)



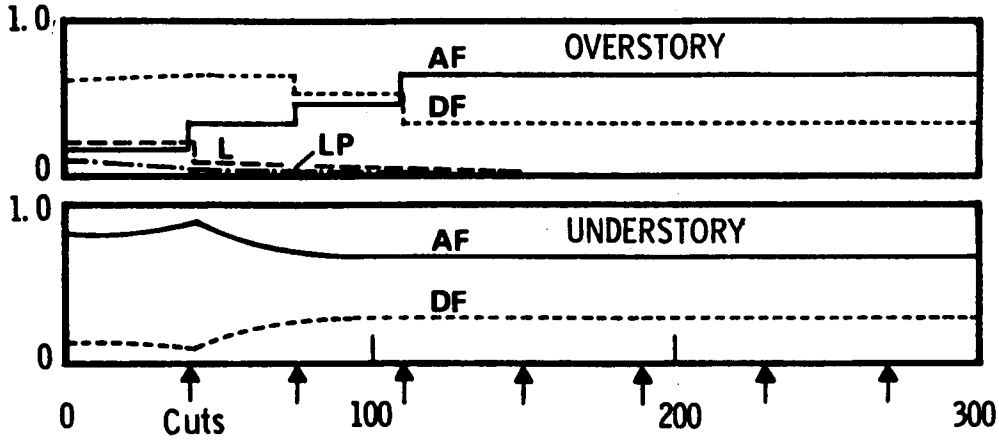
ABSOLUTE NO. OF STEMS

B–1. NATURAL SUCCESSION WITH FIRE CONTROL AND NO CUTTING



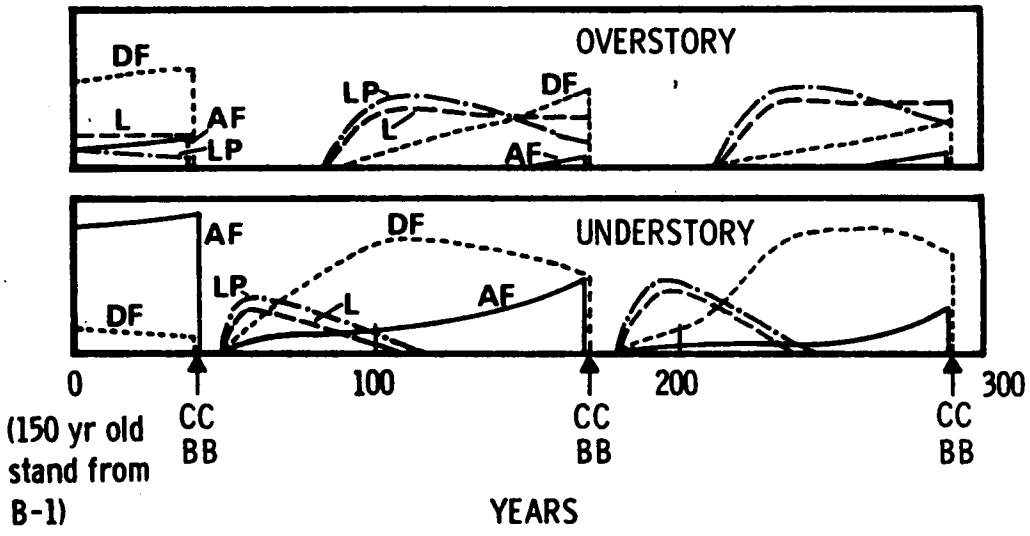
RELATIVE NO. OF STEMS

C-1. PARTIAL CUTTINGS WITHOUT BURNING



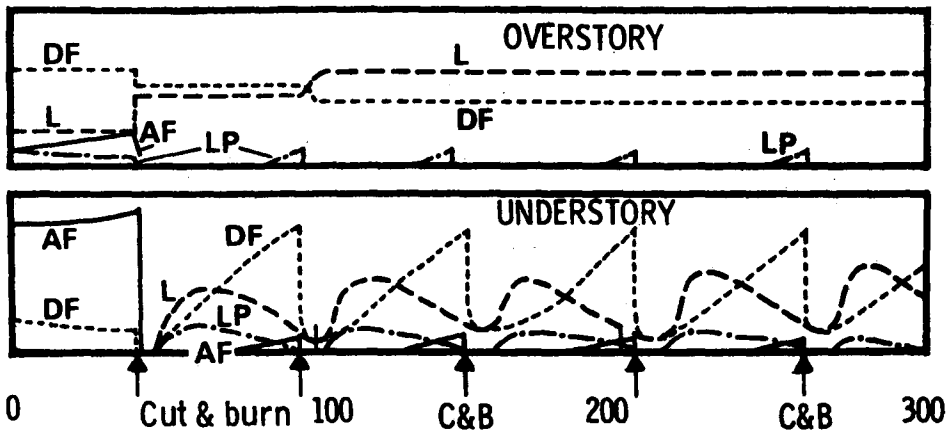
ABSOLUTE NO. OF STEMS

D. CLEARCUTTING WITH BROADCAST-BURNING AT 120 YEAR INTERVALS



ABSOLUTE NO. OF STEMS

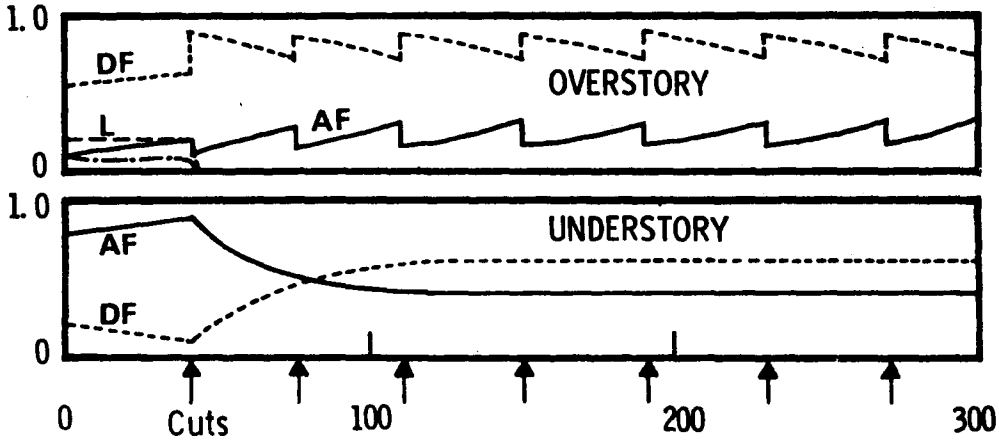
E. SELECTION SYSTEM TO FAVOR LARCH AND DOUGLAS-FIR AND PRESCRIBED UNDERBURNS



(150 yr old stand from B-1)

RELATIVE NO. OF STEMS

F. SELECTION SYSTEM TO FAVOR DOUGLAS-FIR, WITHOUT UNDERBURNING



(150 yr old stand from B-1)

YEARS

IV. Abies lasiocarpa/Xerophyllum h.t., cold phase

Natural Succession With Natural Fire

Figure A shows a typical pattern of tree succession in a pre-settlement stand in the cold phase of the Abies lasiocarpa/Xerophyllum h.t. Both stand-replacing fires and low to medium intensity ground fires occurred at various intervals. Lodgepole pine was favored by fire treatments; whereas subalpine fir became the climax dominant after 200 years or more without fire. Only small amounts of Douglas-fir, Engelmann spruce, and whitebark pine occur with the two major species in this phase, and these minor components will be ignored in this discussion.

Natural Succession With Fire Suppression

Figure B-1 represents the successional pattern that would apparently occur with prolonged fire suppression in the same type of primeval stand. Lodgepole pine gradually gives way to subalpine fir, first in the regeneration layer and finally in the overstory after more than 200 years without fire.

Partial Cutting Without Burning (Speed up of Natural Succession)

The probable effects of economically motivated partial cuttings are shown in Figure C-1. The initial stand in this case is equivalent to the 150 year old stand shown in Figure B-1. Partial cuttings remove much of the lodgepole pine and, without site preparation, this species regenerates only in small amounts. Subalpine fir soon dominates all layers.

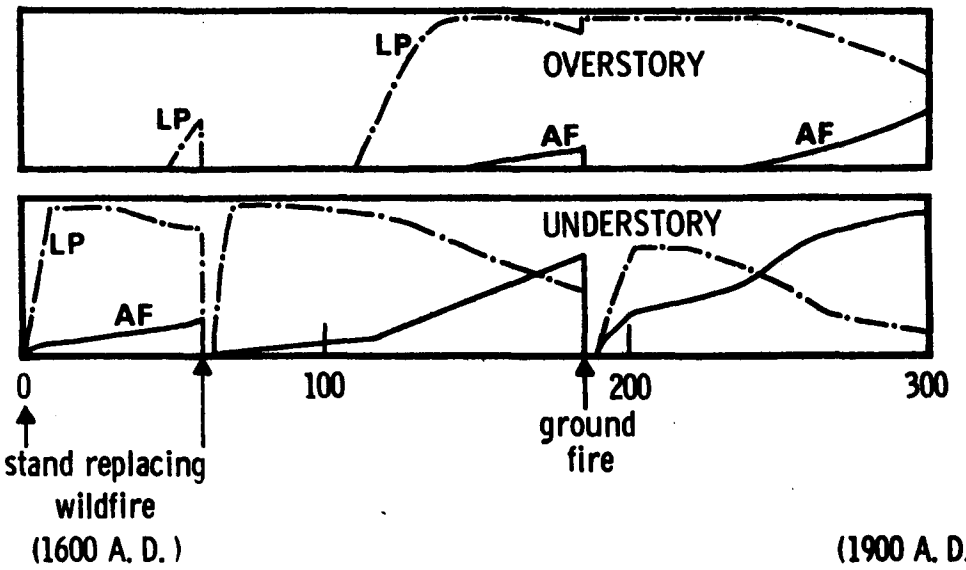
Clearcutting

Figure D shows probable effects of clearcut-broadcast burn or other site preparation treatments made every 130 years, starting with a stand comparable to that in Figure C-1. This treatment results in development of nearly pure lodgepole pine overstories. Clearcutting carried out without burning or site preparation would generally result in stands dominated by lodgepole pine, but often with substantial amounts of subalpine fir also.

HYPOTHETICAL PATTERNS OF TREE SPECIES SUCCESSION ON THE ABIES LASIOCARPA/ XEROPHYLLUM H. T., (COLD PHASE), IN WESTERN MONTANA, AFTER VARIOUS TYPES OF TREATMENTS.

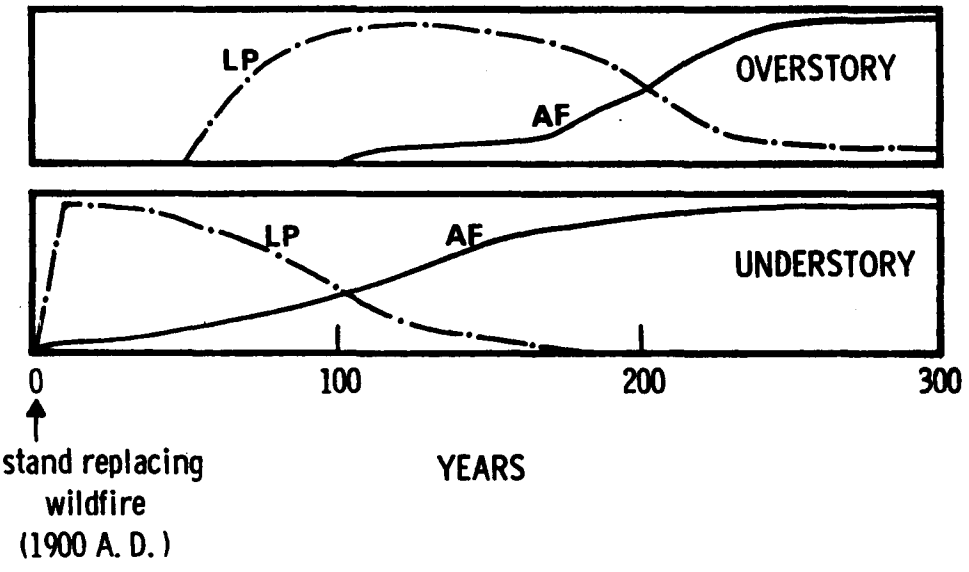
ABSOLUTE NO. OF STEMS

A. NATURAL SUCCESSION WITH NATURAL FIRE
(Some stand replacement fires and some underburns)

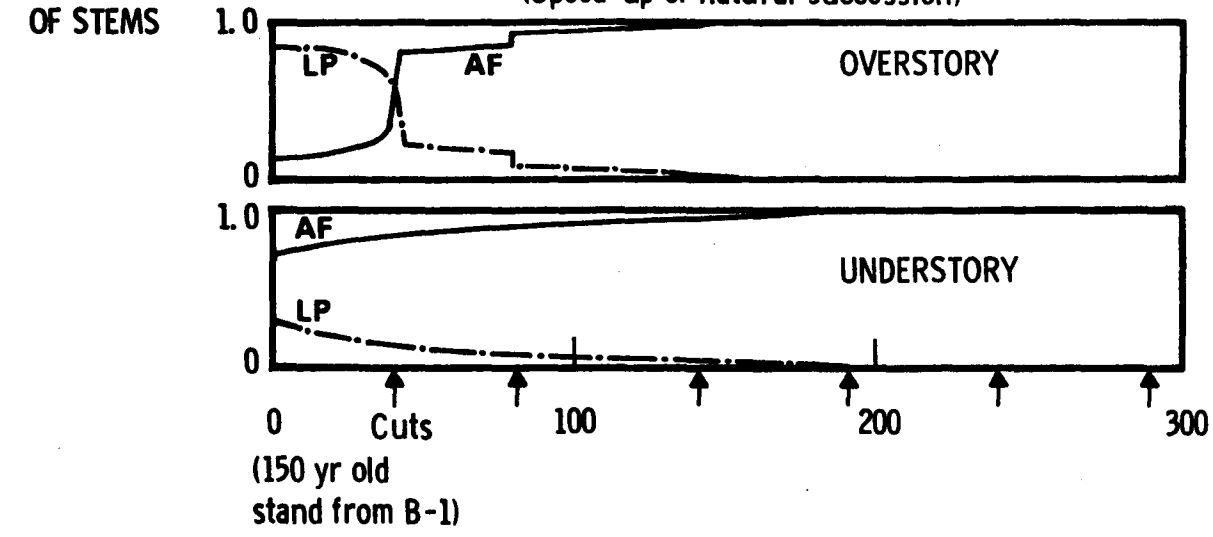


ABSOLUTE NO. OF STEMS

B–1. NATURAL SUCCESSION WITH FIRE CONTROL AND NO CUTTING



C-1. PARTIAL CUTTINGS WITHOUT BURNING
(Speed-up of natural succession)



D. CLEARCUTTING WITH BROADCAST-BURNING OR OTHER SITE PREPARATION AT 130 YEAR INTERVALS